REPORT

ON THE

DRAINAGE AND SEWERAGE

OF THE

City of Montreal,

SHEWING THE LOCATION, AND ESTIMATED COST OF THE SYSTEM OF MAIN OUTLET AND INTERCEPTING SEWERS PROPOSED TO BE CONSTRUCTED FOR THE THOROUGH AND EFFECTUAL DRAINAGE OF THE CITY,

BY

JOHN P. DOYLE, C.E.,

CITY SURVEYOR.

MADE BY ORDER OF THE COMMON COUNCIL,

HENRY STARNES, Esq, *Mayor*.

Montreal:

PRINTED BY J. STARKE & CO., ST. FRANÇOIS XAVIER STREET.

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CITY SURVEYOR'S OFFICE,
City Hall,
MONTREAL, *May* 22*nd*, 1857.

To the Mayor, Aldermen, and Common Council,
Of the City of Montreal.

GENTLEMEN :

At the Quarterly Meeting of Council, held at the City Hall on 9th of September, 1856, a Resolution was passed to the effect that the City Surveyor be instructed to make such examinations and surveys of the City as would enable him to project and lay down such a system of main sewers as would thoroughly and effectually drain the City, and to submit plans, sections and estimates of the cost of said main sewers so required. These instructions—an outline of which is given above—I received in the beginning of October, the delay being occasioned on account of there being no funds appropriated for the purposes of the survey. I commenced the survey and examinations on the 3rd of October, 1856, and since then have devoted all the time to its completion which I could spare from other more pressing duties.

This survey, which you intrusted me with, is now completed, and I have the honor to submit to you the following Report on the system of main sewers which I propose to lay down. This Report is accompanied with a detailed estimate of the cost of all the main sewers proposed to be constructed, and taken out in separate items as the different lengths of sewer and the work on it, is heavy or light; also detailed plans of the side entrances, cross-drains; the outlet at Ruisseau Migeon; plans and sections of the several junctions of the sewers; plans and sections of the main sewers, shewing the details of construction, and their proposed fall and depth below the surface; plans, sections and elevations of public privies and urinals to be constructed in connection

with the main sewers; sections of the old main sewers, shewing the manner in which the sediment is deposited in them; a plan of the City, shewing the streets in which main sewers, or sewers of brick, wood or stone are constructed now, with their depths below the surface, &c., and a plan of the City, with the lines of main sewers marked out upon it as proposed now to be constructed, and drawn in strong blue lines from the commencement of each to its outlet at Ruisseau Migeon.* This last plan has drawn upon it in red figures, the relative heights of the different streets at their intersections, and forms the basis of the calculations from which the selections of the ground to locate the main sewers has been made.

The coping of Cote St. Paul Lock I took as the starting point of the levels, and was 56.28 feet above the surface of the water in the Harbour, (Queen's Basin), when the levels were taken, on the 22nd of November, 1856—the River being then at its lowest. It was also made the starting point of the survey as being immediately beyond and near the ridge at the Tanneries that divides the River St. Pierre from the drainage of the swamp lying west of Bonaventure Street, outside the City limits. I have made a separate survey of all the leading streets in the City, and connected these surveys by running proper check lines between them, so that in future this survey may be made available for a more general and detailed survey of the City, which for the purposes of preventing incroachments on the streets, and for the better defining of private property, and the drainage of houses and yards, should be proceeded with as soon as the main drainage is completed. The plan of the City, shewing the position and direction of the intended main sewers, is drawn to a scale of 400 ft. to 1 inch, and the plan shewing the present state of the sewers, drains and culverts, is drawn to double that scale.

I thought, previous to examining, that I should find in the

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* The plans, sections, and detailed drainings of the sewers have not been lithographed, owing to the cost and delay of time which would be incurred by so doing; but a topographical plan of the City, shewing the position and direction of all the main sewers, as well as the valley of the River St. Pierre, has been lithographed, and is attached, to illustrate this Report.

office plans of the streets through which the main sewers are to pass near enough to make estimates by; but as I should have some of them to survey, and as others of them were plotted to different scales, and the maps were very old, I came to the conclusion of making a new survey throughout the whole extent of the routes proposed to be traversed by the main sewers. Having had to make this survey new in every portion of it, has delayed the Report and the Estimates much beyond the time when I thought they would be ready. The principal objects of the survey are two:—1st. To ascertain the length correctly of the sewers proposed to be constructed, in order to make the estimates of their cost; and 2ndly, To find out the drainage area of the City within the City limits, as also the area of the country outside the limits that drains into the several creeks passing through the City, and which will be intercepted and turned out of their natural channels when the main sewers are constructed. The drainage area of the City and suburbs was required in order to calculate the capacity of the main sewers, and particularly the main outlet, as the whole of the sewerage is intended to pass through one main sewer from Papineau Road to the Outlet at Ruisseau Migeon, or St. Mary's Toll Gate, should it be chosen as the point of delivery. During last winter I have made notes of the several changes in the rising of the river from the taking of the ice in December to its breaking up in the end of April, and I will be able from those notes to approximately estimate the difference of level between the rise of the water in the Queen's Basin, caused by the packing and grounding of the floating ice in the Current St. Mary, and the level of the water at Ruisseau Migeon, which also is partially backed up the whole of the winter. I have also carefully examined the river, from Point St. Charles to about a mile below Ruisseau Migeon, so as to make myself acquainted with the shore all the way, in order to select that part of it which would be best suited for the main outlet of the system of sewers proposed. In projecting a system of main sewers for the City of Montreal, it is necessary to take into consideration the fact that at present there are in existence 22 miles in length of brick and stone sewers, and 3½ miles of wooden drains, within the City, and through which, at the present time, the whole of the rain-

water and sewerage passes into the river. Should it be possible to lay down a system of which the old sewers would form a part, then a great saving would arise from not having the portion of the old sewers retained to construct anew. It is evident, then, the first ground of inquiry should be as to the present state of the main sewers, their levels and construction, and generally whether they would be of any value in a properly extended system such as the one about to be proposed. The whole of the sewerage, soil water and rain water, passes into the river now through three outlets, representing three of the largest natural drainages into which the City is divided. The first, and by far the largest of these, outlets into the Elgin Basin, opposite the Custom House. It takes the whole of the drainage of the City lying between St. Lawrence Main Street and the ridge dividing the waters of the creek which runs by the Lachine Railway station from the River St. Pierre, the waters of the swamp under Coteau Baron; as well as the drainage of Point St. Charles which comes through the Culvert under the Canal. These several drainages unite at Dow's Brewery, and flows through the College grounds in an open channel to St. Ann's Market, and from thence in a covered culvert, built of stone, and arched over, to the outlet at the Elgin Basin. It will be seen that a large portion of this sewerage water flows in open courses, the sides and banks of which are very dirty, from the accumulation of filth of all kinds from time to time deposited there and left by the water, when its depth and flow was not strong enough to remove it. This drainage division of the City embraces Griffintown and the most thickly populated portion of the Craig Street valley. The rainwater and sewerage of the Craig Street valley from Saint Lawrence Main Street, flows through the main sewer known as the Craig Street Tunnel to St. Antoine Bridge, and thence in open cut to Chaboillez Square and Dow's Brewery, joining the creek coming by the Lachine Railway station, mentioned before, shewing that at Dow's Brewery the principal drainages of this division meet and unite in one stream. The Craig Street Tunnel Sewer, between St. Lawrence Main Street and St. Antoine Bridge, was originally a circle of about 7 feet diameter, constructed of 8 inch brick work in common mortar. From quick sand having been

met with in the excavation, and the difficulties to be overcome owing to this cause, and from the "cradling" or foundation timbers giving way, (if any such timbers were used) in many portions of the work, the sewer, particularly in the bottom, has sunk in some places 2 feet; consequently it is now completely out of shape, so much so that it is hard to say from its present appearance what would be the transverse section of it when put down. The dotted lines on the Section No. 1, shew the levels of the bottom of the Craig Street Tunnel and its relative position with respect to the new main sewer proposed to be laid down under this system; from which it will be seen that in its deepest part, at St. Lawrence Main Street, its bottom does not come within 10½ feet of being deep enough. Moreover, the little fall it has is to the Haymarket, being 5½ feet between St. Lawrence Main Street and St. Antoine Bridge, and is in an opposite direction to the fall given to the main sewer as designed to suit the general system here described. It is therefore evident the whole of it will have to be taken up. In the estimates I have made provision for lowering and joining with circular junctions all the collateral sewers to the main sewer throughout the length of Craig Street. There will be a large quantity of earth remaining out of the cut for this new main sewer, which can be used to fill the old sewer in Craig Street when the new system is ready to be used; but, in the estimates, I have made no allowance for such ramming and filling of the old sewers.

The next outlet is that of the main tunnel sewer from Craig Street under Dalhousie Square, and into the river opposite the Barracks. This sewer takes all the drainage from St. Lawrence Main Street to the Papineau Road, and extending as far north-west as a point beyond St. Catherine Street, which is about 600 feet from where the creek crosses Visitation Street. This sewer is constructed of two four-inch brick rings in common mortar, egg shaped, dimensions 6′.0″ x 4′.9″, from St. Lawrence Main Street to where it enters the River St. Lawrence; but is a wooden box—dimensions 32″ x 24″ in bottom, x 30″ in top—from Lacroix Street to Panet Street. The dotted lines on the section show the position of this sewer, no portion of which will be of any use in connection with the new system, and will all have to be filled and the outlet at

the Barracks completely blocked up. This filling in I have not made any provision for in the estimates. The third outlet is into the river at Molson's wharf from the sewer down Papineau Road and Monarque Street. This sewer now takes the drainage of the far end of St. Catherine Street, the low ground beyond the Gaol and the waters of the creeks—having their rise, one beyond the St. Lawrence Toll-gate, draining the table land there, and running west of Logan's Farm, and east to Fullum Street; the other rising beyond the City limits at the head of Papineau Road, and running in the direction of said Road, joining the last named creek at and running in one stream through Papineau Square. The sewer in Papineau Road and Square will also be of no use in the new system of sewers.* I propose to take it up and put down one at a lower level, for the double purpose of a Relieving Sewer and the drainage of St. Mary Street and streets adjacent thereto. (See Section No. 5). This Relieving Sewer need not be built until the works on the other main sewers had progressed partly near completion. I have made arrangements to connect the waters of the several creeks draining now through the old sewer in Papineau Road with the new main sewer by a stone junction, the cost of which is included in the estimates. The old wooden main sewer in St. Charles Barromée Street, which takes the drainage from the swamp at Coteau Baron and from the Mountain and high land above Sherbrooke Street, can be made use of for that purpose till the two main sewers described further on are constructed, and until the buildings will have accumulated in the neighbourhood of Sherbrooke Street as to fairly require its construction for sewerage purposes. This will be about four years hence, or when the whole of the proposed main sewers are constructed. The main sewer in Union Avenue, running through Phillips' Square and St. Radegonde Street to Craig Street is in pretty good condition, and can be made use of for the drainage of the streets in that neighborhood as far as Cathcart Street, at

* This old sewer can be made available for the drainage of this district, should it be thought advisable to delay the construction of the new main sewer which would occupy its place, and running west to Visitation Street, until the other main sewers are laid down, and when the district by being built on would, for drainage purposes, require it.

which it is 12.'6" below the surface; beyond this it is too shallow and comes too near the surface to afford a proper level for the drainage of St. Catherine Street. When the ground between St. Catherine Street and Sherbrooke Street is built on, the sewer in St. Catherine Street will have to be taken up and built according to the Section No. 8 submitted, at such a depth below the surface as to be lower than the gas and water pipes, and with sufficient fall to take the whole of the drainage from Guy Street and to continue through to Bleury Street, turning down that street to the main sewer intended to pass through Berthelet Street. (See plan of City.)

Having now stated the condition and alterations which it will be necessary to make in the old main sewers, I propose to speak of the condition generally of the collateral sewers and drains, the manner in which they have been constructed, and how they will be affected or disturbed by the new system of sewers proposed to be laid down.

OLD SEWERS AND DRAINS.

The old collateral sewers existing in the City vary in size from 18 to 36 inches, and are constructed half a brick thick up to 24 inches; beyond this size, one brick in thickness, laid with common mortar, in the sides and arches—the bottoms, in almost every case, without mortar. The transverse sections of these sewers are, in every instance, circular. Some of these sewers have been constructed as far back as 1840, some time previous to the City being incorporated. In all the old sewers where the common mortar has had such a freedom from moisture as to allow it to set, the arches of such sewers are found to stand well; but in many of them the mortar has never set, and remains in a semi-glutinous state or is washed out of the joints altogether; the consequence of which is that the arches and sides of many of these sewers are deformed and completely flattened, and season after season portions of them keep falling in still as the sewage from the sewer escapes into the surrounding earth and softens and causes it to change—the sewers, not having the firm earth to support them at the sides as when constructed, alter in form and fall in as above described. In my Annual Report laid

before the Council, on the 9th of last March, I submitted a statement shewing the streets in which brick, stone or wooden sewers have been constructed, with the depths below the surface; cost, per lineal yard; and the year in which they were put down; with very full information respecting the old sewers in general, to which I refer you, and need not, therefore, go into detailed explanations respecting them here.

To such an extent has this been the case in many streets (namely, falling in of sewers), that the cost of these repairs from year to year would at the outset have constructed proper sewers, set in cement mortar, wanting little or no repairs, and lasting for a century. Another great evil of constructing the brick sewers of common mortar, or leaving the joints of the brick work in the bottoms without mortar, is that in many instances the runs of water through the sewers being but small, the velocity is small in like manner, and time is afforded the liquid portions of the sewage to go through the brick-work into the surrounding earth, as it would through a sieve, leaving the solid matter deposited on the bottoms of the sewers, causing an obstruction which gradually accumulates till the sewer is completely filled with solid matter that cannot be removed but by hand labor and by breaking up the sewer. Examples of this state of the old sewers are given on sheet No. 4. This fault arises partly from the above cause of bad construction, and partly from the collateral sewers not having fall enough to make the velocity of the sewage greater and which would not allow a deposit to take place. The want of velocity in the collateral sewers is caused by not being placed at proper levels, deep enough below the surface, and with a uniform fall. In the old system, as it now stands, these sewers could have been placed at a uniform fall, but could not be laid in many instances any deeper; because the Craig Street tunnel, which was the main outlet sewer of the system, was not properly constructed and laid at a deeper level. This must appear evident from the fact that the difference of level between the centre of Craig Street at St. Lawrence Main Street is only 5½ feet above the centre of Craig Street at St. Antoine Bridge, and at this point the tunnel outlets on the surface into an open creek, which also has very little fall. Many of the collateral sewers are filled

with the semi-fluid matter of the sewage and soil water from the houses; which, if it had an outlet low enough, would run off, leaving them free of sewage. In the main sewers of the new system I have designed them sufficiently low to give a good fall as an outlet to all the collateral sewers; and in the estimates I have included, as can be seen, the cost of lowering and constructing all these old sewers with circular junctions at their outlets immediately abutting on the new main sewers. It is thought that many of these old sewers when so altered are good and need not be replaced for years, and, when they are in good order, can be flushed and cleaned so as to give free passage for the sewer waters. It is therefore obvious that it will be wisdom to retain and make use of all of them in connection with the new system, which, when properly joined and formed at the outlets, will be found strong and in good condition. Many of them, however, must be altered and lowered as the works progress; and as the streets get built on to such an extent as that they would not in their present condition be able to carry off the sewage, so will the time be proportionally long or short in which they would require to be altered.

The cost of all the immediate alterations necessary I have provided for in the estimates.

The length of wooden drains within the City is about three and one half miles. Many of these are not able to perform the functions of a drain from the quantity of sediment contained in them, and from their being laid at wrong levels, owing to the outlets being into creeks or shallow sewers, which make this kind of drainage nothing more than being on the surface. When the new main sewers are constructed all the wooden box drains ought to be replaced with good brick sewers, properly graduated as to size, and the areas draining into them.

DRAINAGE AND SEWERAGE.

I have in the preceding pages fully stated the condition of the old sewers and drains, as existing now, within the City, and condemned the construction of them as built with common mortar; and, before proceeding to describe the system I propose to lay down, it is necessary to inquire, in what does a proper system of drainage

and sewerage consist; how and of what ought the sewers to be constructed; and what are the essential conditions necessary to effect the thorough drainage of a City. The things essential to the carrying out of a proper and thorough system of sewerage and drainage are—First, That the sewers and house-drains be built of materials impermeable to water of such a depth below the surface as to drain the basement stories, admitting into them soil-water from stables, kitchens, yards and water-closets, as well as rain-water and all other matters capable of being removed by or suspended in water and produced in and about dwelling-houses, which, if retained, might contaminate the air and prove destructive to health, and that all those liquid and partially solid matters be removed beyond the limits of the City. 2ndly, That the sewers be constructed and laid so as to admit all underground springs, if any are met with, to drain into them through openings left purposely, thereby insuring the perfect drainage of the strata to the full depth of the sewer; and that the main sewers be built large enough to admit of men going into them for examination and repairs; and that it be also a distinctly understood principle that the sewers be made perfectly water-tight, except in cases where it is necessary to leave openings as named above.—3rdly, That the whole of the sewage and refuse be so disposed of as not to be offensive to the sight or smell, nor be allowed to pollute the creeks, water-courses, rivers, or natural outlets in the vicinity of the City; but should be applied to agricultural purposes, either in its liquid state or formed into a solid similar to guano, by being chemically precipitated, and in that state conveyed to the land. The first of these conditions is insured by building the sewers and drains of good hard burnt bricks, moulded and made specially to suit the radii of the curves of the inverts and arches of the sewers laid in cement mortar, smooth inside and non-absorbent, and presenting an even surface to the flow of water, and by constructing a sewer or drain in every street and square; and that every house, yard and water-closet have its own drain. The joinings of the sewers, brick sewers and house-drains, should be made circular so as to give a uniform flow in the mains; and both sewers and drains should be properly ventilated and trapped, so as to prevent the escape of noxious gasses

into the streets and houses. The carrying out of this condition embraces the details of the construction of main sewers, cross-drains and gully shoots to take off the surface water from streets, the construction of water-closets, and drainage of houses and yards. Condition No. 2 is partly fulfilled in the carrying out of Condition No. 1, and embraces the application of known principles to particular cases of construction which the peculiarities of a City may present, and which cannot be known but by a thorough and searching inquiry as regards the state of the subsoil, depth of cellars, &c., and which particular cases the sewers ought to be constructed as much as possible to suit, without at the same time interfering with the general and economical design of making the sewers, as to depth, of the greatest use to the greatest number. The third Condition embraces the disposing of the sewage, and is of vital importance; because, if wasted by being discharged into a river or creek, its money value would be lost to the citizens. Moreover, the outlet should be selected with judgment, so that the discharged sewage be not offensive to the inhabitants of any portion of the City; making it therefore imperative to select an outlet far removed from the City. If the sewage is chemically treated in any way so as to get its valuable constituents to apply to the land, or if it be applied as a liquid manure, the money value of the sewage will be in proportion to the successful manner in which this is done, and the management displayed on it.

The subjects embraced under these conditions or principles involve the discussion and inquiry into the kind and quality of sewers and drains best to be used in Town drainage; the kind of materials, size and shape of sewers, and manner of construction; making of roads, and the whole subject of paving; and the falls and levels required in streets to properly throw off the surface waters; together with the calculations and details explaining, according to the several circumstances of each particular locality, whether it would be advisable to make any use of the sewage for agricultural purposes; and the consideration of all other matters which can be said to be connected with sewerage works.

In this Report I shall strictly confine myself to the question

of the main drainage of the City, and in treating of that shall not mix other matters with it only as little as possible, although they might be said really to be involved in the same inquiry. Having given a description of the state and condition of the old sewers and drains, and pointed out their defects, I will now describe generally the areas to be drained; the districts of the City in which the main sewers will be situated; the manner of their selection to the areas they drain; and my reasons for the system which I propose to construct; keeping in view the essential conditions and principles before laid down, and necessary to insure perfect drainage and sewerage.

THE CITY OF MONTREAL is situated on the north bank of the River St. Lawrence on an island of the same name, inclosed between the River St. Lawrence, the River Ottawa, and the River des Prairies. Portions of the natural drainage of the island flow into each of the above named Rivers. But the whole of the drainage of the City, within its present limits, flows into the River St. Lawrence. Should the limits be shifted as is contemplated to the red dotted lines shewn on the plan, to embrace the Tanneries, Cote-des-Neiges, Mile End, and Ruisseau Migeon, some of the drainage of the City within those limits would flow into the River des Prairies, namely: the back part of the Mountain, and the ridge beyond Mile End. These limits would embrace an area of over eight square miles, or 5,300 acres; and the present limits include within them an area of 3,626 acres, all the drainage of which passes through the City to the River St. Lawrence by the outfalls before named. About 5,000 acres of the drainage of the eight square miles of country would have to be provided for in the sewers under any circumstances, irrespective of the City limits. The City occupies the slopes and crests, with the valleys lying between, of a series of ridges running from N. W. to N. E., nearly parallel with the River St. Lawrence. These ridges rise from the river to Notre Dame and St. Mary Streets (being at Dalhousie Square 71.78 feet above the summer level of water in Queen's Basin), falling to Craig Street, rising again to Beaver Hall, from thence rising to Sherbrooke Street and Coteau Baron, and finally ascending the Mountain, a large portion of which is within the City limits. The substratum is Trap Rock, Whyn

and Lime Stone, same as that in the bed of the River St. Lawrence. The earth over the trap rock is all a water deposit, and consists of blue clay, mixed in many places with small stones, sand and gravel, and a stiff clay overlaying all. There is no doubt but the sea once covered the greater part of the island, marine shells having been discovered by Sir Wm. Logan as high up on the Mountain as 430 feet above the level of the River St. Lawrence. In sinking a sewer in McGill College Avenue, last year, where the excavation was 14 feet deep, I came on an innumerable quantity of small marine shells in a finely powdered blue clay, all of which had been deposited there by the water. In laying down some of the old sewers, quicksand has been met with in many parts of the City. In the estimates I have, made sufficient allowances for casualties of this kind, should any be met with.

LINES OF MAIN OUTLET AND INTERCEPTING SEWERS PROPOSED.

Sewer No. 1.—I propose in the first scheme to have the main outfall of the whole of the drainage at Ruisseau Migeon, about one mile below the City limits; starting from which the main outlet sewer goes through the ravine at that place, and, curving to the west, traverses the low ground at the back of the Gaol to Papineau Road, (just beyond which it meets the main sewer coming under St. Mary Street from Commissioners' Street); curving to the south it enters Craig Street opposite Visitation Street, thence along Craig Street to St. Antoine Bridge, and curving into St. Bonaventure Street follows that street to the City limits and on to the Water Works road, and intercepting the creek running by the Railway station at Mountain and Seigneurs Streets; at which I contemplate, should it be required in the summer season, and should the waters of the creek there not be enough to keep this sewer clean,—I propose to put on a self-acting stop-gate, and by pumping into the sewer from the New City Water Works, when the water pent up had risen to a certain height, the gate would open and the water would rush along, clearing the sewer completely; when the water would have ran away, the gate of itself would close. On the line of this sewer, from the Water Works

road to opposite the Lachine Railway station, the fall is 8.60 feet, and the difference of level between this last named place and Craig Street at St. Antoine Bridge is 2.80 feet. In order, therefore, that the sewer may be on one uniform fall from the Water Works road to the change of grade at St. Antoine Street, and that it be a sufficient depth below the surface to drain the adjacent streets, I propose to raise the surface of St. Bonaventure Street from Cemetery Street to the City limits, 1¼ feet over the present level of Mountain Street, 3¼ feet over the present level of Guy Street, and coming to nothing at the Water Works road. From the centre of Craig Street at St. Antoine Street, to where the sewer leaves it at Visitation Street, the ground rises to the latter 10¼ feet, and the fall in the sewer to the change of grade near Dorchester Street is 7 feet, having a uniform fall from St. Antoine Bridge to Dorchester Sreet. From this the sewer falls to summer level of river at Ruisseau Migeon 4 feet. It is intended by the present plan to have the whole of the sewage outlet at summer level of water, and to prevent any stagnant water being in the sewer; but, if thought necessary on the location, this section can have double the fall now designed, by placing the level of the bottom of the sewer 4 feet below summer level; consequently the water would rise on its bottom for a length of 5,150 feet, which is an objection. But as the flow would be large, and the current strong, there need not be any apprehension of sediment being deposited. Besides, I intend having a flushing gate at Ruisseau Migeon, to flush the outlet clear of any matter that might lodge there. As now designed, the fall from the bottom of the sewer at the Haymarket to the level of the water at the outlet, is altogether 11 feet, and the distance 18,795 feet. If placed as latterly spoken of—4 feet below low water—the fall in that distance will be 15 feet. If so placed (the average rise of the river in winter being 14 feet over summer level at Ruisseau Migeon), the outlet would be full at high water, the sewer being 18 feet high by 12 feet wide.

Sewer No. 2.—The second main sewer commences at the junction with the Craig Street sewer near Dorchester Street, and running in a straight line by tunnel under the hill a little north of Dalhousie Square, curving round to the west and along Commissioners Street to St. Ann's Market and McGill Street, thence

along William Street to opposite Aqueduct Street, there receiving and intercepting the waters of the creek coming under the Canal from Point St. Charles, and from thence in a straight line by St. Joseph's Toll-gate, and along the Upper Lachine road to the Water Works road.

In order to keep the sewer low enough to drain Griffintown and Point St. Charles, I have put it 15 feet below the surface at McGill Street. And, in order that the sewer may have a uniform fall to where it receives the creek at Aqueduct Street, I propose to raise the surface of William Street from Catherine to Guy Street, which will make McCord Street three feet higher than at present at the crossing of William Street, and will generally raise William Street between the places before mentioned an average depth of 2 feet. (See Section No. 2.) The fall of this sewer from Guy Street to McGill Street is 3 feet; from thence to opposite Wood-yard Street, fall 3 feet; and the tunnel under the hill to junction with the Craig Street sewer, fall 1½ feet. The bottom of the sewer in Craig Street at the Haymarket will be 2 feet higher than the bottom of the sewer at St. Ann's Market.

Sewer No. 3.—I propose to construct a main sewer, 6′.0″ x 4′.0″, down McGill Street, to join those two points; and by putting down stop-gates at those places, viz.: St. Ann's Market and the Haymarket Square, the sewage can be turned during repairs or examination from the Haymarket through Commissioners Street, or from St. Ann's Market through Craig Street, when the sewage would have raised anything beyond 2 feet—it requiring that height to flow from St. Ann's Market to Craig St. It is evident from the fact of the main sewer through Craig Street, although 16 feet below the surface, it is still 2 feet higher than the bottom of the main sewer through Commissioners Street; and therefore the sewage of Griffintown could not be sent through McGill Street and Craig Street to the outlet without first placing the sewer at the Haymarket 18 feet below the surface, and then the fall from there to Ruisseau Migeon would be only 8 feet; consequently, with any amount of flushing the main sewer through Craig Street, if constructed at this grade, would then have so little fall as that sediment would be continually deposited. (See Sections No. 4 & 1.)

Sewer No. 4.—The bottom of the main outlet sewer at Pa-

pineau Road will be 2¾ feet above summer level of water in the St. Lawrence at Molson's Wharf. I propose to put down a Relieving Sewer 6'.0" x 4'.0", for the double purpose of draining St. Mary Street, and in case anything should happen to the outlet Sewer; so that the whole of the sewage can be turned down Papineau Road to the river, whilst examinations and repairs are making. I also propose to have a Relieving outlet into the river at the Custom House, in case anything would be required to be done to the main sewer through Commissioners Street, between that point and its junction with the Craig Street sewer. (See plan of the City, with the sewers marked in blue and numbered.) All the outlets to the river would be closed during the winter, but the one selected as the main outfall for the sewage.

Sewer No. 5.—(See Section 5.)—This sewer would commence at St. Ann's Market at the level of the bottom of the main sewer, through William Street, down McGill Street to Wellington Street, and along this street and under the Canal by culvert to the Grand Trunk Railway, where it crosses St. Pierre Road. This sewer falls 1½ feet from the Canal to William Street, and from the Canal to the Railway 7 feet. It is proposed to make a connection, by a properly constructed stone culvert, between this sewer and the Tail-race at Grand Trunk Street, should the Tail-race be brought that way; so that water enough may be taken to flush the whole system, and with proper stop-gates or flushing valves, send the water from this Tail-race through the mains either along Craig Street or Commissioners Street, as one or the other of these sewers require cleaning. Water can also be taken from the Tail-race where it crosses the creek near Seigneurs Street, by having an over-fall from it into the creek, and would pass under the Canal by the culvert already there, and go into the main sewer at Aqueduct Street.

Sewer No. 6, (See Section 6)—Commences at Craig Street, up St. Charles Borromeé Street to the creek, with a branch to the east through the swamp, and draining the low ground in the neighbourhood of St. Denis Street. From where the creek enters St. Charles Borromeé Street west through the swampy and irregular ground to Berthelet Street, up the latter street to Union Avenue, thence to Victoria Street, up this street to Sherbrooke

Street, where by a culvert it intercepts the mountain stream, which has its rise near the new Reservoir of the Water Works; thence to the west along Sherbrooke Street to opposite the gate of the Priest's Farm, where it is 10 feet below the surface. At this point the drainage of the Priest's Farm flows towards the Toll-gate, and is collected and runs in open stream through the ravine at the Tanneries Village, and into the River St. Pierre at Cote St. Paul Lock. The flow of the sewage and surface water in this main sewer would enter the main in Craig Street with a velocity of from 4 to 7 miles per hour, according as the quantity to be delivered would increase in time of heavy rains, or at the melting of the ice and snow in the spring. It will be seen that the gradients of this sewer are all good, varying from 1 in 48 to 1 in 517. The extra earth left, after putting down this sewer, would be required to form a street through the swamp under Coteau Baron, from Berthelet Street to beyond St. Denis Street, and to fill the creek, which will be intercepted at Sherbrooke Street. The cost of forming this road is not included in the estimates, for the reason that it is my opinion it should be charged to the appropriation for general street improvements.

Sewer No. 7—Commences by a curve of 400 feet radius at the main sewer (to Ruisseau Migeon, but by a tangent to the main at St. Mary's Toll-gate, if that outfall is selected) at Dufresne Street, and running into Fullum Street; up this street, receiving and intercepting both the creeks from Logan's Farm, which has its rise beyond Mile End, and the one from beyond the Toll-gate, head of Papineau Road. From Fullum Street it will run west as far as Visitation Street, taking the drainage of Logan's Farm and Mile End as before stated, with the valley drainage from the ridge which divides the water-shed towards the River St. Lawrence from the water-shed towards the River des Prairies. The gradients of this main sewer are all good, giving in time of rain a flow of at least 5 miles an hour. (See Section No. 7.)

Scheme No. 2, (See Section 9.)—In this scheme it is proposed from the junction of the Craig Street and Commissioners Street sewers—(see plan of City sewers drawn in blue)—to lay down a main sewer as shewn on plan in red, following the route there indicated to the City limits, entering the River St.

Lawrence opposite St. Mary's Toll-gate at summer level of water. This will be a main outlet sewer of 5,245 feet in length, being 5,055 feet shorter than the scheme to Ruisseau Migeon, and costing, as per estimate, £36,386 less. The difference of level between the surface of water in the St. Lawrence opposite St. Mary's Toll-gate and at Ruisseau Migeon is only 10 inches. The fall in the outlet sewer of scheme No. 1, will be less on account of its length than in scheme No. 2; in the former it will be 1 in 2,575, and in the latter 1 in 1,125. But as the velocity increases in proportion to the body of water flowing, and as this must increase towards the outlet, it is not necessary that the main outlet sewer should have a great fall, for what it loses in fall it gains in volume; and further, if made with a good fall, the velocity would be so much increased with this body of water (this sewer having when full, in every yard lineal, 519 c. feet) as to endanger the stability of the masonry of which it is constructed. This, therefore, cannot be urged as an objection. I will now state my reasons for selecting and recommending the outfall at Ruisseau Migeon in preference to the one at St. Mary's Toll-gate.

THE RIVER ST. LAWRENCE IN WINTER.

In Cities which are built on the margins of tidal rivers, they labor under the disadvantage of having the sewers in the low districts filled with the tide water for 16 hours out of the twenty-four. It is evident if the fall in such sewers was small, and they be made to outlet at low water, they would be partially filled always, except a short time, immediately before and after low water. In Montreal, on account of the severity of the winter, and the blocking up and consequent rise of the water in the St. Lawrence for five months of the year, the main and collateral sewers in all the low lying districts, particularly Griffintown, are filled more or less at different times with back water. The grounding and packing of the ice commences at Lake St. Peter, and continues piling and blocking up till it reaches the Harbour. Nearly the whole of the water of the St. Lawrence flows between the City and the island of St. Helens, the distance between the two being 2,100 feet. At Point St. Charles, and at Windmill Point, beds

of trap-rock stretch out into the river a considerable distance, meeting other beds coming from the opposite side, which give the water the direction of flow towards the wharves and through St. Mary's Current. Opposite Longueuil, a series of beds of the same class of rock come out towards Hochelaga Bay for more than two-thirds of the distance across the river; and in many places are visible, in the shape of raised patches or islands, when the water is very low. It is these rocks, together with the Island of St. Helen's, that has caused the water of the St. Lawrence to hug the shore so closely as to form the Bay. The whole of the water, as before stated, has to pass between the Island and the shore, and also between those last named rocks and the shore of the Bay. Before the rise of the river in the Fall, which is generally about the latter end of December, and when the river is partially frozen over, the Current St. Mary swallows millions and millions of tons of solid ice. Field after field of ice, varying from 10 to 800 feet wide, disappear and sink to the bottom, and become packed solid from the bottom to the first surface coat of ice formed on the river. This packing and grounding of the ice occurs at several places between Montreal and Lake St. Peter. But experience proves that in no part of the river is the packing so complete as at the Current St. Mary and in the Harbour of Montreal. It is the grounding of the ice that causes the river to rise in the Fall; and it is also this grounding of large pieces of ice, one on the other, that forms the ice-bridge across the St. Lawrence. Previous to the water having cut its way through the ice-barrier, it rises and continues to rise till its very weight forces a passage, and then the ice-bridge forms. In 1837, previous to the waters of the St. Lawrence cutting through the ice-barrier, so solid was it formed, and to such a height did the River rise, that the inhabitants were obliged to row from place to place by boats through Griffintown, as the water rose and overflowed all the streets in that part of the City. This would give a depth of water of at least 2 feet on Wellington Street. I believe the outfall at St. Mary's Toll-gate would not be below where the ice packs solid, and as the water out of the main outlet sewer would have to force its way through it, together with the pieces of ice brought down through the collateral sewers, we might have more back-

water and flooding if the outlet is there, than we have even now. This will appear more evident when I state that I have every reason to believe that in the Elgin Basin, where the principal outlet of the drainage of the City is now, the ice does not ground solid from the bottom, but allows the water to find its own level as it comes down and joins the river. This would not be the case, in my opinion, if made to outlet as spoken of in Scheme No. 2; and when there is added to this, that the water would not only have to find room for itself but for large pieces of ice that find their way into the sewers, I think there can be no difference of opinion about the superiority of having the outlet at Ruisseau Migeon. Under any circumstances, the outlet at this point, (Current St. Mary), would suffer the same disadvantage as to the rise of the water as if it were in the Harbour of Montreal.—Scheme No. 2 has the advantage of being cheaper, having a greater fall in the distance, and of being able, under similar circumstances, of discharging in a given time a greater quantity of sewage water. The extreme rise of the water in the river at Ruisseau Migeon this winter above the level of water in the river taken when it was at its lowest, on the 22nd November last, was 13.83 feet, or 13 feet 10 inches; so that I conclude the average winter level of water there would be about 14 feet. At the time the water was 13.83 feet at Ruisseau Migeon it was 18 feet above summer level in the Harbour, making a difference of level in the rise of water at the two places upon the data and observations made last winter of 4.17 feet in favor of Ruisseau Migeon. This is equal to nearly half the available fall from the Haymarket to this outlet. It is evident that to whatever height the water will rise in the river at either outlet, it will rise in the sewer to the same height; and that whilst it would rise in the sewer 14 feet if outletting at Ruisseau Migeon, it would rise 18 feet if outletting at St. Mary's Toll-gate or in the Harbour; proving that, in the one case, there would be 3 feet on the bottom of the sewer in the Haymarket, and in the other there would be 7 feet, or it would be completely filled. The following table gives the length, depth below the surface, and the fall of the main sewers as designed to be constructed for the sewerage of the City—the direction and position of which I have already described. (See Appendix Table No. 1.)

SIZE AND SHAPE OF SEWERS.

This is a very important part of the inquiry, because the size of the sewers will augment or lessen the cost, just in proportion as they are large or small; and the shape given to them has a great deal to do with their stability, and their fitness to perform the duties of discharging the semi-solid matter that passes into them. The proportion of all the solid matter entering the sewers is, to all liquid, about as 1 to 96; that is, for 1 of solid 96 would be soil-water or rain-water; and sewers have been known to discharge, without leaving a deposit matter, in which one-fortieth of it was solid. The solid portions of the sewage consist of decayed animal and vegetable matter, and the washings of streets and roads. The velocity required to keep sewers free of deposit and make them self-cleaning, should be at least two miles per hour. This velocity can be had in all the sewers of the system now proposed to be constructed; where that velocity cannot be had, flushing must be resorted to. Throughout the whole of the system of sewers now proposed, water can be sent from the Tail-race, whether it be brought to the east or the west of the City. In calculating the size of sewers necessary to drain given areas of the rain-water falling upon it, the different matters, the produce of house-drains, including the water supply and the excrementitious matters from water-closets, &c., it is usual to find out the sum total of these several quantities in gallons or cubic feet, and make the size of the sewers accordingly. These several quantities for the City of Montreal will be as follows:—If made to outlet at Ruisseau Migeon, the number of acres to be drained will be about 5,000; and, if outletting at St. Mary's Toll-gate, the drainage area will be about 4,300. The rainfall and snow reduced to rain on this area amounts in 12 months to from 30 to 45 inches, the average of a number of years being 36 inches, amounting on the average per month to about 3 inches. From observations made by Judge McCord (see Appendix table 5) on the rainfall from 1836 to 1840 inclusive, the average fall of rain was 36.45 inches, and of snow 18 inches. During that time the greatest fall of rain and snow reduced to rain, in one year, was in 1839, amounting to about 45 inches. Taking that quantity as the greatest downfall of rain and snow here, and allowing the whole of this (less 1-5th or

9 inches, which I will suppose to go into the earth and be evaporated, and which is a very small allowance), namely, 36 inches is the quantity we will have to remove of rain-water, to be carried off by the sewers. That would be 3 inches per month, or about the 1-10th of an inch of rain over the whole area drained per day. This is an ample allowance, and is believed to be much more than would be required to be removed. A large quantity of the snow here, during the winter, goes off by evaporation; and what from that and absorption of the rain in a generally dry climate like ours, it is believed that sewers removing that quantity, with some provision for storm waters, would be amply sufficient. Supposing our population to be now 70,000; that is, 10,000 houses, occupied with an average of 7 persons to each house; and looking forward to the the time when this population will be double what it is now, or 140,000; and hoping the time will come when every house, out of the 20,000 houses necessary to hold this population, will have its water-closet, and drain directly into the main sewers in the streets,—then all the excrementitious matters of this population, as well as soil-water, will have to be carried off by the main sewers. The quantity of water for this population will amount, say at the most—for culinary and domestic purposes, baths and wash-houses, cleaning of streets, and supplying of public fountains—to 40 gallons per head per diem, which is 5,600,000 gallons to be removed in the 24 hours, at the time when our present population will be double the number it is now. Add to these one ton per annum for each one of the population, being the amount of excrementitious matters produced by a human being in the course of a year, and another ton each per annum for the quantity of detritus passing into the sewers consequent on the wear and tear of streets and roads produced by each inhabitant, and we have 280,000 tons a-year from this source also to be removed through the sewers. Then the quantity, from all sources, will stand thus:—A fall of rain of 1 inch in depth on an acre is equal to 101.28 tons; this, multiplied by 5000 acres, the drainage area gives 506,400 tons; which, multiplied by the number of inches of rainfall, viz., 36, gives 18,230,400 tons of rainwater annually to be removed. Add to this 40 x 140,000 x 365, and it gives us, allowing 10 lbs. of

water to a gallon, 9,125,000 tons annual water supply, which, with 280,000 tons of excrementitious matter, will be—

RECAPITULATING.

	Tons.
Annual rain water,	18,230,400
Annual water supply,	9,125,000
Annual product of each inhabitant of excrementitious matter, &c.,	280,000
Total,	27,635,400

tons annually, or 75,713 tons every twenty-four hours, to be carried away by the sewers. It never occurs in the practice of the sewerage of towns that this quantity is to be discharged in regular stated times. On the contrary, in the daily use of water for domestic purposes, and in times of heavy rains, the above quantity would have to be discharged in 12 hours or less; which, with the additional pressure of the water, and consequent increase of velocity at those times, the main sewers now designed are amply able to discharge this quantity in the above time. The main sewer from Papineau Road to Ruisseau Migeon, through which all the sewage of the City is intended to pass, has a sectional area of 173 square feet; being 18 feet high by 12 feet wide, egg shaped, with the small end down; having a fall of 2.05 feet to the mile, and when running full the velocity will be 3.48 feet, or 3 feet 6 inches per second, and will be able to deliver at the outlet 13,265,482 gallons per hour, or 59,220 tons of water per hour; so that in 2 hours it would be able to deliver the greatest allotted quantity which it can ever have to do in the 24. That is, in 12 hours it would deliver at the outlet nine times the quantity above calculated on, namely, 75,713 tons, and which is the quantity arising from all sources in the 24 hours, and which is thought to be more than will ever be required of it to pass. The two principal elements required to be taken into consideration in calculating the size of sewers, are the quantity and the fall. The size will be directly as the quantity required to be delivered, and inversely as the fall or rate of inclination.

This must be clear; for, the greater the fall, the more rapid will be the discharge. The Tables—2 and 3 in the Appendix—

give full and explicit information with respect to the size, velocities and discharges of the main sewers proposed to be constructed, and to which I refer you. The main sewers of this system, as will be seen in Table No. 1, have various rates of inclination, different capacities according to the areas they drain, and are at different depths below the surface. In Table No. 2 is shewn the dimensions, sectional area and frictional area of the main sewers. In Table No. 3 is given the velocity in feet per second and miles per hour, and the discharge in cubic feet which would take place at each section of sewer or at the change of grade, supposing the sewer to be running full and having no more velocity than the Hydraulic mean depth of such a quantity would produce. But this must not be taken as the correct quantity the sewers are able, under the pressure of heavy rains, to deliver; for the actual discharge will exceed the theoretical discharge, or the quantity which theory would allow, by from one-fourth to one-half more. The sewers and their discharges have been calculated from *Eytelwein's* Formula for calculating the capacities and discharges of open streams and water-courses. This Formula is based on the reasoning that "the mean velocity of a stream is uniform when the resistance arising from the friction of the channel is equal to the accelerating force which gives it motion." That is, if the frictional area is $=b$, and the transverse area $=c$; then $\frac{c}{b} = d$ =the hydraulic mean depth of the stream. Now putting

m = mean velocity in a second
d = the hydraulic mean depth, and
f = the fall in two miles:—

the Algebraic expression will be, to find the velocity—

$$m = \tfrac{10}{11}\sqrt{df}$$

Which in words would be, the velocity in feet per second is equal to ten-elevenths of a mean proportional between the hydraulic mean depth and the fall in two miles. This Formula is the best and most generally received for calculating the capacity of sewers, and is the one I have used; but I must state distinctly that experience proves that the discharges, as given by this theoretical rule, are much exceeded in practice—the reason of which I will endeavour to explain. In open streams, &c., the fall is continual

and uniform. In covered sewers it is not so; for, in times of heavy rains, all the collateral sewers and street cross-drains send into the main sewers water with different degrees of velocity, which must very much increase the velocity of the body of water in the main outlet, and which will in times of heavy rain be very accelerated from falling through a great depth to the main stream. This is the cause of the discrepancy between the practice and what theory would allow to pass through the sewers, as given by the Formula. I have no hesitation in saying that the main outlet sewer now proposed from Papineau Road to Ruisseau Migeon will at times have its velocity increased from what this rule allows it to twice or thrice the feet in a second that is named above; so that, in place of discharging 59,220 tons of water per hour, in times of heavy rains and storms, the velocity of the flow will be so rapid as to discharge 100,000 tons in an hour, or nearly double the quantity given by the rule. If the outfall of this sewer was placed as described before, namely, four feet below summer level of water in the river at Ruisseau Migeon, and making an allowance for 5,150 feet of its bottom, between Papineau Road and the outlet, being covered with water, it would have a velocity of nearly five feet in a second, and would, if full, theoretically discharge 85,185 tons per hour, which is equal to 19,081,532 gallons. If I had calculated the discharge of the sewers by the Formula of Sir John Leslie, the sewers which I have designed would discharge considerably more theoretically; but I thought it better to proportion them in accordance with *Eytelwein's* experience; for then I am sure to be, if anything erring, on the right side, for the sewers will be found to discharge more than I have stated. As the main outlet sewer from Papineau Road to Ruisseau Migeon involves one-third of the whole expenditure, it may be asked why I did not make it smaller and endeavour to reduce the expense, seeing that it is able to discharge more than ten times the quantity that will be theoretically required of it? I answer, should the sewer be made to outlet as designed at level of low water, and as the winter level over that point, even at Ruisseau Migeon, is 14 feet higher, I have made the sewer 4 feet higher than the average height of winter floods, in order to afford headway for the water in times or

heavy rains, and to prevent the likelihood of having the sewer bursted by the pressure of water at flood time. Moreover, making the sewer 4 feet higher does not much increase the expense; for it would have to be excavated to the full depth that it is intended to be, no matter what the size of the sewer put down, so that very little would be saved in excavation.

SHAPE OF SEWERS.

The most experienced Engineers who have written on the subject of the drainage of towns give it as their opinion, and state experience proves, that the circular or eliptically shaped sewer is the best, as being the strongest, having the largest sectioned area, and is the strongest to withstand the pressure of the superincumbent earth. All the sewers of this system I have designed to be egg-shaped, with the small end down, affording room for floods in the top part when the water rises, and when the flow is small concentrating it in a small circle in the bottom—(See cross sections of sewers, figures 1 to 11, sheet No. 1, and Table No. 2.)

HOUSE-DRAINS AND CROSS-DRAINS.

The house-drains of the present old system are very defective, and should be remedied. No wooden house-drains should, under any circumstances, be allowed to be put down.

The object of a system of main sewers is to afford an outlet for the street and house-drainage of the City. I should therefore advise, that still as the main sewers are constructed, that powers be obtained to compel all the proprietors on each side of the street to put down brick or glazed stone-ware drains; and that gradually as the sewer works extend, open cesspools and privies be abolished, and water-closets in the houses be adopted instead. The great object of main drainage is for the benefit of house drainage; therefore, one is useless without the other.

The street cross-drains I propose in future to construct of glazed stone-ware pipes, as shewn on Drawing No. 2. Sections of the house-drains in glazed stone-ware, and of the stone-ware sewers for small streets, are shewn on Sheet No. 1.

THE FLUSHING OF SEWERS.

Under any circumstances, large quantities of street dirt and other solid substances, will find its way into the sewers through the gully grates, as at present constructed. This occurs because at the end of the winter here there is a five months' dirt on the streets, and the heavy showers of rain in the spring at the breaking up of the ice are found to wash a great deal of this into the sewers. I intend to make liberal use of the water from the Tail-race and from the blow-off cocks of the New Water Works for the purpose of flushing or washing away this dirt to the outlet and into the river. I propose also to make use of the sewer in Sherbrooke Street, by connecting it with the old Reservoir on Coteau Baron, to flush out all the old sewers down in to Craig Street. In other parts of the City provision can be likewise made to cleanse and flush the sewers. The Tail-race water can be used always for this purpose; but not so from the water-pipes, for the time will come when the Water Works will have enough to do to supply the water required for domestic and other uses, namely, when the population will have increased considerably more than its present numbers. It is therefore necessary that the gully grates be trapped to prevent the street dirt from being washed into the sewers. The manner in which I propose to do this is shewn on Sheet No. 1.

CONSTRUCTION OF SEWERS.

The main outlet sewer from Papineau Road to Ruisseau Migeon or to St. Mary's Toll-gate, if that outlet be chosen, I propose to construct 18 feet high by 12 feet wide, egg shaped, in coursed rubble masonry, in cement—the work to be 18 inches thick, and hammer-dressed smooth to give an even water-way. This and the elevation, as shewn on Sheet No. 8, together with six stone culverts as inlets for the creeks, &c., are all the stone masonry to be constructed. The remaining portions of the sewers I propose to construct of brick-work, varying from 8 inches to 16 inches in thickness, all set in cement of the best quality. From the junction at Papineau Road there will be two portions of the main sewers tunnelled. One, under St. Mary Street, will have to be worked in a tunnel; but the other may, if thought the most

advantageous, be worked partly in open cut and partly in tunnel; that is, 100 feet might be excavated in open cut, and 100 feet tunnelled. I propose to use a frame-work of timbers as a lining to support the superincumbent earth as the tunnel work progresses; and when the brick-work is constructed inside of this shield or lining, to solidly pack in and ram hard with earth between said brick-work and the timber lining, and of course let the timbers remain in the work. In some places, where the earth is good and self-supporting, this lining might be moved on and not left in the work; but, in the estimates, I have calculated as if the whole of the timbers were buried in the work, and consequently no error in defect of estimates can arise from this cause. The works in each division, if let to different contractors, would be commenced at the end nearest the outlet, so that the surplus water might run off through the portion of the sewer still as constructed.

PUBLIC NECESSARIES AND URINALS.

In the estimates, I have given a list of the streets and public places at which I think it will be necessary to construct public privies, both for the use of the citizens in the day time, and for strangers from the country who come daily to our markets with their produce. I have also given the names of streets in which it will be necessary to erect urinals. The places selected for those last are opposite dead walls, and in situations near the cab-stands, where their use will prevent the disgusting exhibitions now to be witnessed at those places and at the markets, for the want of such conveniences.

The urinals are intended to be made of corrugated iron, with a cast iron cap or hood, fitting with a flange, to which the upright portion is revited. These urinals need not be used in the winter, but can be closed up with cast iron doors. The public privies are intended to be constructed of cut stone in front, with inner walls of brick. The estimated cost of the public privies includes the fiting up of each with water closets, water pipes, drains, &c., and does not include the price of the land on which they are to be erected. In the winter the privies would be closed, except the two at St. Ann's Market and the

Bonsecours Market, which it will be necessary to keep open for the use of the country people and farmers, as no doubt they suffer very much now every year for the want of conveniences such as these.

The cost of the urinals and necessaries named in the estimates, is :—

Urinals, ...	£ 360	0	0
Public Necessaries, ...	3600	0	0
Total, ...	£3960	0	0

(See SHEET No. 7, for plans, sections and elevations of privies and urinals.)

VALUE OF THE SEWAGE AS A MANURE.

I am fully convinced that the sewage of towns is of great value to grass lands, or lands under tillage, applied in its liquid state. Experience in different parts of Europe—at Milan and Edinburgh particularly—fully bears out this. There is also evidence of the value of applying to lands the productive properties of the sewage, when obtained in a solid state, by chemical precipitation; and it is in this way I think it will eventually come to be generally applied. From the cheapness of land in our midst, and in Canada generally, and from its productive qualities even in a natural state, I would not advise the Council to go to any expense in making settling reservoirs, or any other means, to get the value of the sewage now. But when the time comes (as undoubtedly it will come) that this kind of manure will be demanded and used by the public, the whole of the sewage can be put under chemical treatment at the outlet of the system here designed, in such a way as, at very little expense, to obtain all of it that is of value to the land.

ESTIMATES.

It is intended the prices named in the estimates will fully pay for the several items of work to which they are attached, as well as the necessary centering for the arches and inverts, and superintendence on the part of the contractor during the progress of the works. It is thought that quicksand will be met with in a large portion of the excavation for the main sewers; but as I

have not had time to make any borings to test this, I cannot say with confidence to what extent it will occur. I have made, however, liberal provision for timber foundations, and I am fully confident the 10 per cent. added for contingencies will, with care and prudent management, fully complete the works herein mentioned and described within the estimates submitted. The price for the masonry in the outlet sewer is large; but it must be borne in mind that a great portion of it will have to be laid below 20 feet, and the stones will have to be dressed on two faces for the inverts.

GENERAL SUMMARY OF THE ESTIMATES OF THE COST OF CONSTRUCTING THE MAIN SEWERS —CITY OF MONTREAL.

SCHEME NO 1.

Outletting at Ruisseau Migeon.

	£	s.	d.
Sewer No. 1—Estimate of the main sewer from Ruisseau Migeon to Papineau Road, and through Craig street to the City Boundary and beyond to the Water Works Road	154,585	11	3
Sewer No. 2—Estimated cost of Commissioners street sewer throughout	55,499	9	5
Sewer No. 3—Estimate of relieving sewer in McGill street, both for the purposes of flushing and drainage	2,844	7	0
Sewer No. 4—Estimate of relieving sewer in Papineau Road, both for the purposes of flushing and drainage	3,583	13	0
Sewer No. 5—Estimate of the sewer in Wellington street, from McGill street to Canal Bridge, thence to the Railway Crossing.....	8,073	6	0
Sewer No. 6—Estimate of the sewer up St. Charles Borromee street, and through Berthelet street, thence to Sherbrooke street and along to opposite Priests' Farm gate, also the branch going east through the swamp foot of Coteau Baron	15,995	5	6
Sewer No. 7—Estimate of the sewer from junction at Dufresne street, up Fullum street and west of Visitation street.....	7,963	19	6
Bailing and pumping water out of the trenches not already provided for	2,000	0	0
Estimate of proposed improvements in connection with the sewers, viz: Public Urinals and Necessaries.....	3,960	0	0
	£254,505	11	8
10 per cent. for contingencies	25,450	11	2
Total cost of Scheme No. 1	£279,956	2	10

SCHEME No. 2.

Proposed to outlet at St. Mary's Tollgate.

	£	s.	d.
Total cost of sewers, main, relieving and intercepting, as far as Papineau Road, as per estimate No. 1, and common to both schemes	152,675	9	5
Cost of outlet as proposed opposite St. Mary's Tollgate	62,791	18	0
Bailing and Pumping water out of the trenches, not already provided for	2,000	0	0
Public Urinals and Necessaries	3,960	3	0
	£221,427	7	5
10 per cent for contingencies	22,142	14	9
Total cost of Scheme No. 2	£243,570	2	2

Total cost of Scheme No. 1, outletting at Ruisseau Migeon, leaving out the Sewers up St. Charles Borromée street, and west along Berthelet and Sherbrooke streets, and under Cote à Baron, as also the sewer up Dufresne street and west to Visitation street, all of which it is proposed to construct four years hence	226,586	6	8
Cost of Public Urinals and Necessaries	3,960	0	0
	£230,546	6	8
10 per cent for contingencies	23,054	12	8
Total cost	£253,600	19	4

Total cost of Scheme No 2, leaving out the above described Sewers to be constructed four years hence	£193,508	2	5
Public Urinals and Necessaries	3,960	0	0
	£197,468	2	5
10 per cent for contingencies	19,746	16	3
Total cost	£217,214	18	8

TOTAL SUMMARY.

Total cost of Scheme No. 1, outletting at Ruisseau Migeon	£279,956	2	10
Do. do. do. leaving out sewers to be constructed four years hence	253,600	19	4
Total cost of Scheme No. 2, outletting at St. Mary's Toll-gate.	243,570	2	2
Do. do. do. leaving out sewers to be constructed four years hence	217,214	18	8
Scheme No. 1, main outlet at Ruisseau Migeon	95,870	2	3
Ten per cent. contingencies	9,587	0	2
Total cost	£105,457	2	5
Scheme No. 2, main outlet at St. Mary's Toll-gate	62,791	18	0
Ten per cent. contingencies	6,279	3	9
Total cost	£69,071	1	9
Sum of the difference of the cost of the main outlets	£36,386	0	8

CONCLUSION.

The sewers up St. Charles Borromée Street, and west through Berthelet Street and Sherbrooke Street to the Priests' Farm; and the sewer up Fullum Street, and west to Visitation Street, need not be built for three or four years, or till the lots in the neighbourhood of those streets would require more extensive sewerage. But at the end of that time they will require to be constructed, and could not be longer delayed. The whole of those sewers can be constructed in sections, so that any one of them can be commenced with separately after the main outlet is constructed. The main outlet to Ruisseau Migeon, or to St. Mary's Toll-gate, would have to be constructed before the works were commenced on any of the others, in order to give facilities for drainage. This restriction does not apply to the relieving sewers through McGill Street and Papineau Road, as they can be constructed independent of the two main sewers through Craig and Commissioners Streets; because one for the time being could drain into the creek at St. Ann's Market, and the other into the river at Molson's Wharf. Either of these sewers could be commenced this season, as also the main outlet to St. Mary's Toll-gate, if selected, and finished before the winter. For the reasons stated in the body of this Report, I strongly urge upon you to select Ruisseau Migeon as the outlet for the sewage, and to build the outlet sewer from Papineau Road to there of stone, in cement mortar. To take the sewage to St. Mary's Toll-gate would be the cheapest; but it would be discharging the sewage near a thickly populated part of the City; and, as regards winter floods, would very likely have the City in as bad a condition as it is at present. Moreover, in a work of such permanency and utility as this, a few thousand pounds should not be spared, when its application would undoubtedly be in the end the most advantageous to the citizens. The fall in the river from the Harbour to Ruisseau Migeon is 2 feet 8 inches, and the water rises in the Harbour (Queen's Basin) from 4 to 8 feet higher, according to the grounding and the blocking of the ice in the Current St. Mary, than it does at Ruisseau Migeon. Consequently, the gain in the fall, by making the outlet at Ruisseau Migeon, will be from 6 ft. 8 inches to 10 feet 8 inches, varying and depending on the character of

the stoppage of the ice barrier in the winter. The length of the main outlet and intercepting sewers, for which estimates are now submitted, is 14 miles 1241 yards. The estimated cost of the sewers, to outlet at Ruisseau Migeon, is £279,956 2s. 10d.; and if made to outlet into the river opposite St. Mary's Toll-gate, is £243,570 2s. 2d.—making a difference of £36,386 0s. 8d. cy. Taking into consideration the effect which the Victoria Bridge is likely to have on the waters of the River St. Lawrence in winter, by causing a considerable rise in the river above the Bridge, I think, no matter where the Tail-race is brought, provision must be made in the sewers to take a large body of such flood water, or else Griffintown will be flooded as it was last winter. I have, therefore, made the sewers larger to meet this on that account. It is also necessary to the thorough drainage of that part of the City to divert the River St. Pierre from its present course, and make it outlet below the Bridge, and dam up the ravine through which it passes at its confluence with the River St. Lawrence. This will form a necessary part of any plan for getting rid of the Tail-race water, both for the purpose of keeping back water from the wheels of the New Water Works, and to increase the power of said Tail-race in its application to the moving of machinery, and consequently add to the revenue derivable therefrom, as also to keep the adjacent lands from being flooded. I have made provision for taking a large quantity of the Tail-race water to flush the sewers. In order not to take away from the waters of the Tail-race when they might be advantageously employed for moving machinery in the day time, the waters therefrom for flushing purposes can be taken in the evening or the night time equally as well as day for that purpose. To carry out those works economically and in a permanent manner, it will be very necessary that at least six months of preparation be made in the furnishing of properly moulded bricks and other materials suitable for the construction of sewers on so large a scale. As nearly the whole of the distribution pipes for the water supply has to be put down yet; I beg to bring prominently before your notice the great saving that will arise to the city, amounting to many thousand pounds, if the water pipes and the sewers could be put down at the same time, thereby avoiding tearing up the

streets a second time, and saving the cost of excavation for the water pipes, as they can be laid in the sewer trenches at their proper depth. I feel it to be my duty before closing this Report to inform you, that from the bad state of the old sewers, and their being full of sediment, consequently the house drains do not perform their functions in a satisfactory manner. The sanatory condition of the city is such, that if cholera or fever of a typhoid character were to visit us, the consequence would be to our citizens very dreadful indeed, and has now come to that state as to require your earliest and most serious consideration. The amount included in the estimates for these works is very large, and on that account I have deemed it prudent to go more fully into details for your satisfaction than under other circumstances it would be necessary for me to do.

All of which I respectfully submit.

JOHN P. DOYLE,
City Surveyor.

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APPENDIX

TO

THE REPORT

ON THE

DRAINAGE AND SEWERAGE

OF THE

City of Montreal,

SHEWING

DETAILED ESTIMATE OF THE COST, AS WELL AS TABLES SHEWING THE SIZE, SECTIONAL AREAS, FRICTION AREAS, VELOCITIES,

AND

DISCHARGES OF THE SEWERS.

May, 1857.

DETAILED ESTIMATE

OF THE

COST OF PUTTING DOWN THE MAIN SEWERS,

CITY OF MONTREAL.

SECTION No. 1.	£	s.	d.	£	s.	d.
Estimate of the Main Sewer from Ruisseau Migeon to Papineau Road, and through Craig street, to the City Boundary, and beyond to the Water Works Road.						
Estimate of the Main Outlet Ruisseau Migeon:—						
Rubble backing in masonry of outlet, 618½ yards, at 25s.	772	18	4			
Faced ashlar in outlet, 512 yards .. .. at 75s.	1920	0	0			
Coffer dam and pumping	150	0	0			
250 piles, each 15 feet long=3750 feet .. at 1s.	187	10	0			
7000 lbs. iron shoeing, 28 lbs. ⅌ pile .. .. at 5d.	145	16	8			
Waling pieces and cross-timbers over piles, 317 ft. at 1s.	15	17	0			
107 Tamarac planks for flooring	8	0	0			
Excavation for foundation courses, 285 cub. yds. at 1s. 3d.	17	16	3			
	3217	18	3			
Deduct 70 cubic yards void at outlet .. .. at 40s.	140	0	0			
				3077	18	3
SECTION No. 1—continued.						
Estimate of Sewer 18′ x 12′, from Ruisseau Migeon to Papineau Road, invert in coursed rubble masonry in cement, arch uncoursed in cement.						
30,327 cubic yards of coursed rubble masonry in cement throughout .. .. at 40s.	60654	0	0			
66,759 cubic yards of excavation, out of invert, average depth below the surface 3′ 2″ .. .. at 4s.	13351	16	0			
106,814 cubic yards of excavation from springing of invert, average depth 19′ 2″ .. .. .. at 2s.	10681	8	0			
Carried over	84687	4	0	3077	18	3

	£			£	s.	d.
Brought over	84687	4	0	3077	18	3
80,100 cubic yards of back filling over arch of sewer, including ramming .. .. at 1s.	4005	0	0			
4,000 feet timber cradling for invert .. .. at 4s.	800	0	0			
500 cubic yards concrete to form bed for invert at 20s.	500	0	0			
12,000 feet of timber shoreing, left in work to keep banks from slipping and destroying the sewer .. at 6d	300	0	0			
2 stop gates, with crab engines to lift them	300	0	0			
5 side entrances for examinations and repairs.. ..	500	0	0			
50 cross drains to take off surface water .. £12	600	0	0			
100 junctions circular for future sewers and house drains 100s	500	0	0			
Pumping and bailing out water during construction of this section	600	0	0			
				92792	4	0
SECTION No. 1—continued.						
Estimate of Tunnel Sewer, being that portion of the Craig street Main Sewer from Papineau Road to St. Hubert street.						
Excavation from Papineau Road to St. Hubert street, 19,687 cubic yards .. .. at 5s.	4921	15	0			
1,233⅓ lineal yards of sewer, 10′ 6″ x 7′ 0″ in cement, including cement, bricklaying, and labor at £8 6s. 3d.	10252	7	11			
1,425,000 feet of timber and plank for lining and supporting earth over arch .. .. .. at £6 per 1000	8530	0	0			
Earth filling between timber lining and brick work, including ramming 3015 cubic yards .. .. at 10s.	1507	10	0			
Timber cradling, including excavation for transverse sleepers, 2000 feet .. .. at 4s.	400	0	0			
4 side entrances for examinations and repairs at £110 each	440	0	0			
12 cross drains to take off surface water .. at £12	144	0	0			
10 old house drains altered .. .. .. at 80s.	40	0	0			
300 cubic yards of concrete to form bed for invert at 20s.	300	0	0			
20 circular junctions for intended sewers .. at 100s.	100	0	0			
4 junctions of old sewers altered .. .. at £12	48	0	0			
6 old cross drains altered .. .. .. at 100s.	30	0	0			
30 junctions opposite lots and houses for intended house drains as the work progresses .. .. at 40s.	60	0	0			
Bailing and pumping	500	0	0			
4 shafts for air and working tunnel	600	0	0			
				27873	12	11
SECTION No. 2.						
Estimate of portion of Brick Sewer 10′ 6″ x 7′ 0″, *from St. Hubert street to St. Charles Borromee street. Average depth below the surface* 25′ 3″.						
6382 cubic yards of excavation for invert .. at 4s.	1276	8	0			
17,903 cubic yards of excavation over arch .. at 2s.	1790	6	0			
Carried over	3066	14	0	123743	15	2

	£	s.	d.	£	s.	d.
Brought over	3066	14	0	123743	15	2
861¾ lineal yards of sewer .. .. at £8 6s. 3d.	7162	12	1			
13,428 cub. yards of earth back filling and ramming at 1s.	671	8	0			
2585 feet timber cradling under invert .. at 4s.	517	0	0			
Concrete for foundation and forming bed for masonry of invert on cradling, 278 cubic yards .. at 20s.	278	0	0			
3000 feet timber shoreing left in trench .. at 6d.	75	0	0			
7 junctions and alterations for old sewers .. at £15	105	0	0			
7 junctions for intended sewers .. .. at 100s.	35	0	0			
3 side entrances for examination, &c.	300	0	0			
40 junctions for house drains .. .. .. at 40s.	80	0	0			
15 old house drains altered .. .. .. at 60s.	45	0	0			
8 old cross drains altered .. .. .. at 100s.	40	0	0			
6 additional cross drains to take off surface water at £12	72	0	0			
				12447	14	1
SECTION No. 2—continued.						
Estimate of the portion of the Craig street Sewer between St. Charles Borromee street and the Haymarket square Average depth below the surface 19′ 6″.						
2701 cubic yards of excavation in invert, and 8840 cubic yards over arch = 11,541 cubic yards .. at 2s. 6d.	1442	12	6			
736¾ lineal yards of brick sewer in cement, including labor, &c. .. .. at £5 4s.	3832	0	0			
6630 cubic yards of earth back filling .. .. at 9d.	248	12	6			
2210 feet timber cradling under invert .. at 4s.	442	0	0			
208 cubic yards concrete to form bed for brickwork in invert .. .. at 20s.	208	0	0			
3000 feet timber shoreing left in trench .. at 6d.	75	0	0			
9 junctions and alterations of old sewers .. at £15	135	0	0			
20 old cross drains altered .. .. .. at 100s.	100	0	0			
50 junctions for new house drains .. .. at 40s.	100	0	0			
Connecting 10 old house drains .. .. at 60s.	30	0	0			
1 stop gate at Haymarket square to turn sewerage during repairs down McGill street, including fittings &c.	100	0	0			
4 side entrances for examination, &c	400	0	0			
8 new cross drains .. .. at £12	96	0	0			
				7209	5	0
SECTION No. 3.						
Estimate of that portion of the Craig street Sewer from Haymarket square to South-west City Boundary.						
2221¾ lineal yards brick sewer in cement .. at 57s. 6d.	6387	6	2			
13,206 cubic yards of excavation,—average depth 10′ 9″, including shoreing up .. .. at 1s. 6d.	890	9	0			
6667 cubic yards of back filling and ramming at 6d.	166	13	6			
4000 feet timber cradling under invert .. at 3s.	600	0	0			
300 cubic yards of concrete to form bed for invert at 20s.	300	0	0			
3000 feet timber shoreing left in trench .. at 6d.	75	0	0			
Carried over	8419	8	8	143400	14	3

	£	s.	d.	£	s.	d.
Brought over	8419	8	8	143400	14	3
6 junctions of old sewers circularly let into main sewer, including excavation .. .. at £15	90	0	0			
12 alterations of old cross drains .. .. at 100s.	60	0	0			
40 junctions for new house sewers .. .. at 40s.	80	0	0			
12 old house drains made good and let into main sewer .. .. at 60s.	36	0	0			
1 stop gate at Guy street for flushing	70	0	0			
6 side entrances for repairs, &c. .. .. at £60	360	0	0			
29 circular junctions for new sewers .. .. at 100s.	145	0	0			
16 new cross drains put in complete .. .. at £8	128	0	0			
				9388	8	8
SECTION No. 3—continued.						
Estimate of that portion of the Craig street Sewer from South-west City Boundary to the Water Works Road, 5′ 3″ x 3′ 6″, all in cement. Average depth below the surface 12′ 9″.						
3443 cubic yards of earth excavation .. .. at 1s.	162	3	0			
1500 cubic yards of back filling and ramming at 6d.	37	10	0			
463½ lineal yards of brick sewer, including laying and labor .. .. at 46s.	926	15	4			
Flushing gate at Water Works Road, and enlarged portion of sewer to lock water for flushing purposes ..	200	0	0			
2 side entrances for examinations, &c.	120	0	0			
10 cross drains to take off surface water	100	0	0			
30 junctions for new house drains .. .. at 40s.	60	0	0			
1000 feet of cradling for invert .. .. .. at 2s. 6d.	125	0	0			
6 junctions for new sewers .. .. .. at 100s.	30	0	0			
1400 feet timber shoreing left in trench .. at 6d.	35	0	0			
				1796	8	4
				154585	11	3

SECTION No. 4.

SEWER No. 2.—*Estimate of Tunnel Sewer under the hill at St. Mary's street, from junction with the Craig street sewer to Commissioner street, opposite Woodyard street. Average depth below surface 40′ 10″.*

	£	s.	d.	£	s.	d.
12,702 cubic yards of excavation .. at 7s. 6d.	4763	5	0			
2100 cub. yards of earth back filling and ramming at 10s.	1050	0	0			
815,000 feet of timber lining to support earth over brickwork .. .. at £6 per M.	4890	0	0			
2307 lineal feet of cradling for invert .. .. at 4s.	6461	8	0			
200 cub. yards of concrete to form bed for invert at 20s.	200	0	0			
769 lineal yards of sewer in cement .. at £8 6s. 3d.	6389	16	3			
Pumping and draining tunnel	400	0	0			
5 air shafts to work and construct tunnel .. at £150	750	0	0			
				18904	9	3

SECTION No. 4.—Sewer No. 2—continued.

Estimate of Sewer through Commissioner street, from Woodyard street to McGill street. Average depth below the surface 18′ 7″.

31,327 cubic yards of earth excavation .. at 2s. 6d.	3916	17	6			
14,000 cubic yards of back filling, &c. .. at 9d.	525	0	0			
1666⅔ lineal yards of brick sewer .. at £8 6s. 3d.	13754	8	4			
3000 feet of cradling .. .. at 3s.	450	0	0			
6000 feet of timber left in trench .. .. at 6d.	150	0	0			
40 old cross drains connected with sewer .. at 100s.	200	0	0			
400 cubic yards of concrete bedding for invert at 20s.	400	0	0			
20 old house drains connected with sewer .. at 60s.	60	0	0			
7 old sewers lowered and connected with main at £10	70	0	0			
3 side entrances for examination, &c.	300	0	0			
40 junctions for new house drains .. .. at 40s.	80	0	0			
1 stop gate and fittings opposite the Montreal House	100	0	0			
Stone outlet to the river at the Montreal House ..	300	0	0			
1 stop gate at the bottom of McGill street	100	0	0			
				20406	5	10

SECTION No. 5.

Estimate of that portion of Commissioner street Sewer, 7′ 6″ x 5′ 0″, from McGill street, through William street, to opposite Guy street. Average depth below the surface 12′ 0″.

13,874 cubic yards of earth excavation .. at 1s. 6d.	1040	11	0			
6000 cubic yards of earth back filling .. .. at 6d.	150	0	0			
1541⅓ lineal yards of brick sewer .. .. at £5 4s.	8016	13	4			
3000 feet of cradling .. .. at 3s.	450	0	0			
4000 feet of timber left in trench .. .. at 6d.	100	0	0			
200 cubic yards of concrete for bed for invert at 20s.	200	0	0			
Carried over	9957	4	4	39310	15	1

	£	s.	d.	£	s.	d.
Brought over	9957	4	4	39310	15	1
1 stop gate and fittings	100	0	0			
12 old cross drains lowered and let into sewer at 60s.	36	0	0			
4 old sewers joined and let into main	40	0	0			
30 junctions for new house drains .. .. at 40s.	60	0	0			
18 circular junctions for sewers to be made .. at 100s	90	0	0			
10 new cross drains .. .. at £12	120	0	0			
3 side entrances for examinations, &c. .. at £70	210	0	0			
				10613	4	4
SECTION No. 5—continued.						
Estimate of that portion of Commissioner street Sewer from Guy street to the Water Works Road, 5' 3" x 3' 6". Average depth below the surface 13' 7".						
41,132 cubic yards of earth excavation .. at 1s. 6d.	834	18	0			
4500 cub. yards of earth back filling and ramming at 6d.	112	10	0			
1473½ lineal yards of brick sewer .. .. at 46s	3903	2	0			
4 side entrances .. .. at £70	280	0	0			
20 new cross drains .. .. at £10	200	0	0			
13 junctions for new sewers .. .. .. at 100s.	65	0	0			
2 stop gates for flushing purposes .. .. at £70	140	0	0			
20 junctions for house drains .. .. .. at 40s	40	0	0			
				5557	10	[illegible]
Total cost of sewer No. 2				55499	9	5

	£	s.	d.	£	s.	d.
SECTION No. 6.						
SEWER No. 3.—*Estimate of Relieving Sewer in McGill street, both for the purposes of Flushing and Drainage, so that the sewage of either sewer can be turned through the other. Average depth below the surface* 18′ 2″; *Sewer* 6′ 0″ x 4′ 0″.						
6006 cubic yards of earth excavation .. .. at 2s.	600	12	0			
4000 cub. yards of earth back filling and ramming at 9d.	150	0	0			
530 lineal yards of brick sewer in cement, including labor of laying, &c. .. .. at 57s. 6d.	1523	15	0			
7 old drains lowered and let into main .. at £20	140	0	0			
20 old cross drains lowered and let into main at £8	160	0	0			
1 stop gate at Haymarket	70	0	0			
2 side entrances .. .. at £100	200	0	0			
				2844	7	0
SECTION No. 7.						
SEWER No. 4.—*Estimate of the Relieving Sewer in Papineau Road, both for the purposes of Flushing and in case of damage, &c. to the main sewer, between Papineau Road and Ruisseau Migeon the sewage can be turned down Papineau Road to the river.*						
13,659 cubic yards of earth excavation .. at 2s.	1365	18	0			
674 lineal yards of brick sewer in cement, including labor .. .. at 57s. 6d	1937	15	0			
4 old sewers let into main .. .. .. at £15	60	0	0			
8 cross drains to take off surface water	120	0	0			
1 stop gate for flushing	100	0	0			
				3583	13	0
SECTION No. 8.						
SEWER No 5.—*Estimate of Sewer in Wellington street, from McGill street to the Canal Bridge—average depth below the surface* 16′ 0″; *and from the latter to the Railway Crossing—average depth* 12′ 8″.						
10,829 cubic yards of earth excavation .. at 2s.	1082	18	0			
7764 do. do. from Canal Bridge to the Railway Crossing .. .. .. at 1s. 6d.	582	6	0			
2322 lineal yards of brick sewer, including labor of brick laying, &c. .. .. at 46s.	5340	12	0			
5300 cub. yards of earth back filling and ramming at 6d	132	10	0			
Stone culvert and stop gate to connect with tailrace of the Water Works at Grand Trunk street, for flushing the sewers	300	0	0			
10 old sewers lowered and let into main	150	0	0			
15 old house drains let into main .. .. at 60s	45	0	0			
10 new cross drains .. .. at £10	100	0	0			
30 junctions for new house drains .. .. at 40s.	60	0	0			
4 side entrances for repairs .. .. .. at £70	280	0	0			
				8073	6	0
Total cost of sewers No. 3, 4 and 5.. ..				14501	6	0

SECTION No. 9.

	£	s.	d.	£	s.	d.
Sewer No. 6.—*Estimate of the Sewer up St. Charles Borromee street, turning to the west through Berthelet street, thence to Sherbrooke street, and along to opposite the Priests' Farm gate, also the branch going east through the swamp at the foot of Cote a Baron.*						
Sewer up St. Charles Borromee street—average depth below the surface 15′ 11″; sewer 6′ 0″ x 4′ 0″.						
9511 cubic yards of earth excavation from Craig street to the Creek .. .. at 2s.	951	2	0			
5000 cubic yards of back filling and ramming at 6d.	125	0	0			
892 lineal yards of brick sewer in cement at 57s. 6d.	2564	10	0			
2000 feet timber shoreing left in trench at £8 per M.	16	0	0			
1000 feet of cradling for bottom of invert .. at 2s.	100	0	0			
108 cubic yards of concrete for forming of bottom to support invert in different places .. .. at 20s.	100	0	0			
20 old house drains altered .. .. .. at 60s.	60	0	0			
15 old cross drains altered and let into main ..	75	0	0			
20 junctions left for drains to houses and lots at 40s.	40	0	0			
4 new cross drains .. .. at £10	40	0	0			
				4071	12	0
Estimate of portion of Sewer from St. Charles Borromee street to Bleury street—average depth below the surface 12′ 8″; size of sewer 6′ 0″ x 4′ 0″.						
3800 cubic yards of earth excavation .. .. at 1s 6d.	285	0	0			
2000 cub. yards of earth back filling and ramming at 6d.	50	5	0			
450 lineal yards of brick sewer in cement, including labor, centering, &c. .. .. at 57s. 6d.	1293	15	0			
1 old sewer let in and altered	15	0	0			
10 junctions left for drains to houses .. .. at 40s.	20	0	0			
				1664	0	0
Estimate of portion of Sewer from Victoria street to Bleury street, through Berthelet street—average depth below the surface 14′ 9″; sewer 6′ 0″ x 4′ 0″.						
5365 cucic yards of earth excavation .. .. at 1s. 6d.	402	7	6			
3000 cubic yards of back filling and ramming at 6d.	75	0	0			
546 lineal yards of brick sewer in cement, including labor, centering .. .. .. at 57s. 6d.	1569	15	0			
Altering and letting in 2 old sewers	30	0				
4 cross drains altered .. .. at 100s.	20	0	0			
8 new cross drains .. .. at £10	80	0	0			
8 old house drains altered .. .. .. at 60s.	24	0	0			
12 junctions for drains to houses and lots .. at 40s.	24	0	0			
				2225	2	6
Estimate of portion of the Sewer between Metcalf and Victoria streets—average depth below the surface 13′ 0″; sewer 6′ 0″ x 4′ 0″.						
4105 cubic yards of earth excavation .. .. at 1s. 6d.	307	12	6			
Carried over	307	12	6	7960	14	6

	£	s.	d.	£	s.	d.
Brought over	307	12	6	7960	14	6
2500 cub. yards of earth back filling and ramming at 6d.	70	0	0			
474 lineal yards of brick sewer in cement at 57s. 6d.	1362	15	0			
16 junctions for new house drains .. .. at 40s.	32	0	0			
6 cross drains to take off surface water .. at £10	60	0	0			
				1832	7	6
Estimate of portion of Sewer from Metcalf street to opposite the gate at Priests' Farm—average depth below the surface 12′ 6″; size of Sewer 5′ 3″ x 3′ 6″.						
10,020 cubic yards of earth excavation .. at 1s 6d.	751	10	0			
6400 cub. yards of earth back filling and ramming at 6d.	160	0	0			
1319 lineal yards of brick sewer in cement .. at 46s.	3033	14	0			
6 outlets for new sewers .. .. at 100s.	30	0	0			
10 new cross drains .. .. at £19	100	0	0			
15 junctions for house drains and lots .. .. at 40s.	30	0	0			
				4105	4	0
Estimate of portion of Sewer under Coteau Baron through the Swamp—average depth below the surface 4′ 6″.						
2252 cubic yards of excavation and filling .. at 1s.	112	12	0			
3560 cubic yards of earth to cover sewer .. at 1s.	175	0	0			
901 lineal yards of brick sewer in cement at 37s. 6d.	1689	7	6			
Junction to receive the creek beyond St. Denis street	60	0	0			
20 junctions for new drains to houses and lots at 40s.	40	0	0			
4 do. for new sewers .. .. .. at 100s.	20	0	0			
				2096	19	6
Total cost of sewer No. 6				15995	5	6

SECTION No. 10.

	£	s.	d.	£	s.	d.
Sewer No. 7.—*Estimate of Sewer from Junction at Dufresne street up Fullum street and west to Visitation street—average depth up Fullum street 20′ 6″.*						
4804 cubic yards of earth excavation .. .. at 2s.	480	8	0			
3000 cub. yards of earth back filling and ramming at 6d.	75	0	0			
392 lineal yards of brick sewer .. .. .. at £5 4s.	2038	8	0			
6 cross drains .. .. at £10	60	0	0			
20 junctions for house drains .. .. .. at 40s.	40	0	0			
Timber for shoreing left in sewer trench	20	0	0			
				2713	16	0
Portion of Sewer from Fullum street, through the low ground to Visitation street—average depth 17′ 2″.						
13,428 cubic yards of earth excavation .. at 2s.	1342	16	0			
6200 cub. yards of earth back filling and ramming at 6d.	155	0	0			
Timber shoreing left in trench	40	0	0			
1173 lineal yards of brick sewer .. .. at 57s. 6d.	3372	7	6			
20 junctions for drains to houses and lots .. at 40s.	40	0	0			
10 do. for new sewers .. .. .. at 100s.	50	0	0			
15 new cross drains to take off surface water ..	150	0	0			
Junction to receive the creek coming from the low grounds east of Fullum street	100	0	0			
				5250	3	6
Total cost of sewer No. 7				7963	19	6

ESTIMATE OF THE COST

OF

PROPOSED OUTLET No. 2.

	£	s.	d.	£	s.	d.
Estimate of the cost of proposed Outlet No. 2, at the City Boundary, opposite St. Mary's Toll gate, and of the Main Outlet Sewer in connection therewith, from near Papineau Road to the river at the place above mentioned, instead of at Ruisseau Migeon, as proposed in the first scheme—Sewer 18′ x 12′; average depth below the surface 36′ 6″.						
Cost of revetment and protecting walls at Outlet, being more exposed than at Ruisseau Migeon	4500	0	0			
39,075 cubic yards of earth excavation in invert at 4s.	7815	0	0			
91,359 do. do. do. over arch at 2s.	9135	18	0			
79,300 cub. yards of earth back filling and ramming at 1s.	3965	0	0			
15,943 cubic yards of coursed rubble masonry in cement; work 18 inches thick .. .. at 40s.	31886	0	0			
2 stop gates and machinery to lift them	220	0	0			
5 side entrances for examination, &c	500	0	0			
3000 feet of timber cradling for foundation .. at 4s.	600	0	0			
20 cross drains at crossing of streets to take off the surface water .. .. at £12	240	0	0			
12 junctions for new sewers .. .. .. at £15	180	0	0			
30 do. for drains opposite houses and lots at 100s.	150	0	0			
6000 feet of timber shoreing left in sewer trench to keep banks from slipping .. .. at 6d.	150	0	0			
Pumping and bailing out water	400	0	0			
	59741	18	0			
Additional cost by this scheme of portion of connecting sewer between the main sewer and the sewer in Fullum street	3050					
				62791	18	
Total cost of Outlet No. 2				62791	18	0

PROPOSED IMPROVEMENTS

IN CONNECTION WITH THE SEWERS.

Estimate of the cost of erecting public Necessaries and Urinals in the following parts of the City, viz.:—	£	s.	d.	£	s.	d.
PUBLIC URINALS.						
1 at the junction of Fortification lane and Haymarket square	20	0	0			
1 " Fortification lane and St. Francois Xavier street	20	0	0			
2 at St. Ann's Market, by the Nunnery wall	40	0	0			
2 at Bonsecours Market	40	0	0			
2 at Papineau square	40	0	0			
2 at St. Lawrence Market	40	0	0			
3 opposite Canal wharf	60	0	0			
2 at the Champ de Mars	40	0	0			
1 at Parthenais square	20	0	0			
2 by the Gaol wall	40	0	0			
				360	0	0
PUBLIC NECESSARIES.						
1 at St. Ann's Market	600	0	0			
1 at Chaboillez square	600	0	0			
1 at Papineau square	600	0	0			
1 near St. Lawrence Market	600	0	0			
1 near Viger square	600	0	0			
1 near the Canal wharf	600	0	0			
				3600	0	0
Total cost of Public Urinals and Necessaries ..				3960	0	0

GENERAL SUMMARY OF THE ESTIMATES.

SCHEME No. 1.

Outletting at Ruisseau Migeon.

	£ s. d.
Sewer No. 1—Estimate of the main sewer from Ruisseau Migeon to Papineau Road, and through Craig street to the City boundary, and beyond to the Water Works Road	154,585 11 3
Sewer No. 2—Estimate of the cost of Commissioner street sewer throughout	55,499 9 5
Sewer No. 3—Estimate of relieving sewer in McGill street, both for the purposes of flushing and drainage	2,844 7 0
Sewer No. 4—Estimate of relieving sewer in Papineau Road, both for the purposes of flushing and of drainage..	3,583 13 0
Sewer No. 5—Estimate of sewer in Wellington street, from McGill street to Canal bridge, thence to the Railway crossing	8,073 6 0
Sewer No. 6—Estimate of the sewer up St. Charles Borromee street and through Berthelet street, thence to Sherbrooke street,and along to opposite Priests' Farm gate, also the branch going east through the swamp at foot of Cote à Baron	15,995 5 6
Sewer No. 7—Estimate of the sewer from junction at Dufresne street up Fullum street, and west to Visitation street	7,963 19 6
Bailing and pumping water out of the trenches, not already provided for	2,000 0 0
Estimate of proposed improvements in connection with the sewers, viz.: Public Urinals and Necessaries	3,960 0 0
	£254,505 11 8
10 per cent. for contingencies	25,450 11 2
Total cost of Scheme No. 1	£279,956 2 10

SCHEME No. 2.

Proposed to Outlet at St. Mary's Tollgate.

	£ s. d.
Total cost of sewers, main, relieving and intercepting, as far as Papineau Road, as per the above estimate, and common to both Schemes	152,675 9 5
Cost of outlet, as proposed, opposite St. Mary's Tollgate	62,791 18 0
Bailing and pumping water out of the trenches, not already provided for..	2,000 0 0
Public Urinals and Necessaries	3,960 0 0
	£221,427 7 5
10 per cent. for contingencies	22,142 14 9
Total cost of Scheme No. 2	£243,570 2 2

SUMMARY—*Continued.*

	£	s.	d.
Total cost of Scheme No. 1, outletting at Ruisseau Migeon, leaving out the sewers up St. Charles Borromee street, and west along Berthelet and Sherbrooke streets, and under Coteau Baron, as also the sewer up Dufresne street and west to Visitation street, all of which it is proposed to construct four years hence	226,586	6	8
Cost of Public Urinals and Necessaries	3,960	0	0
	£230,546	6	8
10 per cent. for contingencies	23,054	12	8
Total cost	£253,600	18	4

	£	s.	d.
Total cost of Scheme No. 2, leaving out the above described sewers to be constructed four years hence	193,508	2	5
Public Urinals and Necessaries	3,960	0	0
	£197,468	2	5
10 per cent. for contingencies	19,746	16	3
Total cost	£217,214	18	8

TOTAL SUMMARY OF THE ESTIMATES.

	£	s.	d.
Total cost of Scheme No. 1, outletting at Ruisseau Migeon	279,956	2	10
do. do. do. leaving out sewers to be constructed four years hence	253,600	19	4
Total cost of Scheme No. 2, outletting at St. Mary's Tollgate..	243,570	2	2
do. do. do. leaving out sewers to be constructed four years hence	217,214	18	8
Scheme No 1, main outlet at Ruisseau Migeon	95,870	2	3
10 per cent. contingencies	9,587	0	2
Total cost	105,457	2	5
Scheme No. 2, main outlet at St. Mary's Tollgate	62,791	18	0
10 per cent. contingencies	6,279	3	9
Total cost	69,071	1	9
Sum of the difference of the cost of the main outlets	36,386	0	8

TABLE No. 1.

Table shewing the length of each class of Sewer, average depth below the surface, and fall per foot run, as proposed to be laid down for the drainage and sewerage of the City of Montreal.

Class of Sewers.	NAME OF STREET MAIN SEWER.	Length in feet.	Average depth below surface.	Fall per foot run.
			′ ″	
1	Section from Papineau Road through low ground to Ruisseau Migeon	10300	28 1	1 in 2575
1	Section from junction of Commissioner street sewer with Craig street sewer to Papineau Road, thence to outlet into river opposite St. Mary's Tollgate	5245	36 2	1 in 1213 / 1 in 1125
2	From Papineau Road, through Craig street, to St. Charles Borromee street	6285	29 0	1 in 1213
3	Section from St. Charles Borromee street, through Craig street, to Beaver Hall	2210	19 6	1 in 1184
4	Section from Beaver Hall, through St. Bonaventure street, to City Boundary	6665	10 9	1 in 1111
5	Section from City Boundary, through low grounds, to the Water Works Road, (contemplated to be extended at a future time through the swamp to the terminus)	5490	12 9	1 in 467
2	Section from junction of Commissioner street sewer with Craig street sewer, as far as Woodyard street, portion tunnelled	2307	40 10	1 in 1624
2	Section from Woodyard street to McGill street	5000	18 7	1 in 1624
3	Section from McGill street, through William street, to Guy street	4625	12 0	1 in 1541
5	Section from Guy street to Upper Lachine Road	5081	13 7	1 in 432
5	Section from McGill street, through Wellington street, to Wellington Bridge	3655	16 11	1 in 2436
5	From Wellington Bridge to end of sewer near Grand Trunk Railway	3310	12 8	1 in 473
7	From Wellington street along St. Patrick street	5120	11 0	1 in 445
6	Section along Sherbrooke street, from gateway at Priests' Farm, to Guy street	1292	13 7	1 in 517
4	Section along Sherbrooke street, from Guy street to Metcalfe st.	2665	11 5	1 in 85
4	From Metcalfe street, along Sherbrooke street, to Victoria street, then along Victoria street to a point in line with Berthelet st,	1421	13 6	1 in 48
4	From Victoria street, along Berthelet street, to Bleury street	1637	14 10	1 in 113
4	From Bleury street, through ravine, to St. Charles Borromee st.	1350	12 8	1 in 54
4	Section along St. Charles Borromee street to Craig street ..	2675	15 11	1 in 80
6	Section from St. Charles Borromee street, through low ground, to Cote à Baron	2703	4 6	1 in 540
3	From Dufresne street to entrance of low ground east of Fullum street	1175	20 6	1 in 141
4	From entrance to low ground east of Fullum street to Visitation street	3520	17 2	1 in 141
6	From Visitation street to Cote a Baron	1055	12 3	1 in 141
6	From Fullum street west along said street, thence north along low ground	5250	12 2	1 in 618
7	From Guy street along St. Catherine street to McGill College avenue	3085	11 2	1 in 106
4	Section of sewer along Papineau Road	2032	30 3	1 in 728
4	do. do. do.	1731	30 6	1 in 47
7	From McGill College avenue to Berthelet street	2445	14 9	1 in 213

TABLE No. 1—*Continued.*

SUMMARY OF THE LENGTH OF THE MAIN SEWERS.

	Length in Feet.
Sewer from Water Works Road, through Bonaventure street, Craig street, and low ground (behind the Gaol), to Ruisseau Migeon..	26800
Sewer from Water Works Road, through William street, Commissioner street, to junction with Craig street sewer	17013
Sewer from junction of main sewer from Papineau Road to outlet opposite St. Mary's Tollgate	3860
Sewer from Cote à Baron across Papineau Road, along Fullum street, to junction with main sewer at Dufresne street	5750
Sewer from Priests' Farm, Sherbrooke street, along said street, Victoria street, Berthelet street, and through St. Charles Borromee street, to Craig street	11032
Sewer from junction at St. Charles Borromée street, through the low ground, to Cote à Baron	2703
Sewer from junction with Commissioner street sewer at McGill street, through Wellington street, to Grand Trunk Railway	6965
Relieving sewer, Papineau Road, from its junction with main sewer to outlet at Molson's wharf, Monarque street	2032
Relieving sewer, McGill street	1590
Total length in feet	77745

Being 14 miles 1241 yards.

TABLE No. 2.

Table showing the class, dimensions, sectional and frictional areas of the main Sewers and Drains proposed for the sewerage of the City of Montreal.

Class.	Dimensions.	Sectional Area in Square Feet.	Frictional Area in Lineal Feet.	Remarks.
1	18′ 0″ x 12′ 0″	173.0	48.17	Rubble masonry.
2	10 6 x 7 0	55.11	26.75	Four 4 in brick rings.
3	7 6 x 5 0	29.68	19.85	Three do.
4	6 0 x 4 0	18.53	15.94	Two do.
5	5 3 x 3 6	14.68	14.16	" do.
6	4 6 x 3 0	10.62	11.78	" do.
7	3 9 x 2 6	7.32	9.92	" do.
8	3 0 x 2 0	4.82	7.97	One single brick ring.
9	2 3 x 1 6	2.92	5.85	do.

GLAZED STONEWARE PIPE DRAINS,

Proposed for House Drains and Small Sewers.

No.	Diameter.	Sectional area in Square Inches.	Frictional area in Lineal Inches.	Remarks.
1	18 inches.	264.4	56.5	Drain in small street
2	15 "	176.7	47.1	"
3	12 "	113.0	37.6	"
4	9 "	63 6	28.2	House drains.
5	6 "	28.2	18.8	"
6	4 "	12.5	12.5	"

TABLE No. 3.

Table of the velocities of the sewage in feet per second, and miles per hour, in the main sewers proposed for the drainage and sewerage of the City of Montreal, supposing them to run full, as also the quantities they are able to discharge per hour, under these circumstances, at the commencement of each gradient :—

Class of Sewers.	Name of portion of Sewer, with its length and Fall.	Hydraulic mean depth in feet.	Fall in feet per mile.	Velocity in feet per second.	Velocity in miles per hour.	Discharge in cubic feet per hour.
1	Portion of sewer from Ruisseau Migeon to Papineau Road—length 10,300 feet; fall 4 feet	3.59	2.05	3.48	2.37	2,164,853
1	Portion of sewer from junction of Commissioner street sewer with Craig street sewer to Papineau Road—length 1385 feet; fall 1.14 feet	3.59	4.34	5.07	3.45	3,151,368
1	Portion of sewer from Papineau Road to outlet at river opposite St. Mary's Tollgate—length 3860 feet; fall 3.43 feet	3.59	4.69	5.27	3.59	3,279,250
2	From Papineau Road to St. Charles Borromée street,—length 6285 feet; fall 5.18 feet ..	2.06	4.35	3.84	2.61	737,460
3	Portion of sewer from St. Charles Borromee street, through Craig street, to Beaver Hall,—length 2210 feet; fall 1.82 feet	1.49	4.34	3.27	2.23	349,464
4	Portion of sewer from Beaver Hall, through St. Bonaventure street, to City boundary,—length 3665 feet; fall 6 feet	1.16	4.75	3.02	2.05	200,569
5	Portion of sewer from City Boundary to Water Works Road,—length 5490; fall 2.86. ..	1.03	11.53	4.38	2.98	230,980
2	Portion tunneled under hill at St. Mary's street,—length 2307 feet; fall 1.42 feet	2.06	3.25	3.32	2.26	657,616
2	Portion of sewer from Woodyard street to McGill street,—length 5000 feet; fall 3.07 feet ..	2.06	3.25	3.32	2.26	657,616
3	Portion of sewer from McGill street, through William street, to Guy street,—length 4625 feet; fall 3.0 feet	1.49	3.42	2.90	1.97	308,719
5	Portion of sewer from Guy street to Upper Lachine Road,—length 5081 feet; fall 11.76 feet	1.03	12.22	4.55	3.10	240,282
5	Portion of sewer from McGill street, through Wellington street, to Wellington Bridge,—length 3655 feet; fall 1.50 feet	1.03	2.16	1.90	1.29	99,988
5	Portion of sewer from Wellington Bridge to end of sewer near Grand Trunk Railway,—length 3310 feet; fall 6.99 feet	1.03	11.15	4.35	2.96	229,430
7	Portion of sewer from Wellington street along St. Patrick street,—length 5120 feet; fall 11.50 feet	0.73	11.85	3.78	2.57	99,329
6	Portion of sewer along Sherbrooke street, from gateway at Priests' Farm to Guy street,—length 1292 feet; fall 2.49 feet	0.90	12.22	4.26	2.90	162,613
4	Portion of sewer along Sherbrooke street, from Guy street to Metcalfe street,—length 2665 feet; fall 31.35 feet	1.16	62.11	10.90	7.43	726,939
4	Portion of sewer from Metcalfe street, along Sherbrooke street, to Victoria street, thence to a point in line with Berthelet street,—length 1421 feet; fall 29.60 feet	1.16	109.98	14.51	9.89	967,621

TABLE No. 3—*Continued.*

Class of Sewers.	Name of portion of Sewer, with its length and fall.	Hydraulic mean depth in feet.	Fall in feet per mile.	Velocity in feet per second.	Velocity in miles per hour.	Discharge in cubic feet per hour.
4	From Victoria street, along Berthelet street, to Bleury street,—length 1637 feet; fall 14.48 feet	1.16	46.70	9.46	6.44	630,079
4	From Bleury street, through Ravine, to St. Charles Borromée street,—length 1350 feet; fall 25.00 feet	1.16	97.77	13.68	9.32	911,854
4	Portion of sewer along St. Charles Borromée street to Craig street,—length 2675 feet; fall 33.43 feet	1.16	65.98	11.24	7.66	740,442
6	Portion of sewer from St. Charles Borromée street, through low ground, to Cote à Baron,—length 2703 feet; fall 5.00 feet	0.90	9.72	3.80	2.59	145,231
3	Portion of sewer from Dufresne street to entrance of low ground east of Fullum street,—length 1175 feet; fall 8.33 feet	1.49	37.43	9.65	6.57	1,029,587
4	From entrance of low ground east of Fullum street to Visitation street,—length 3520 feet; fall 24.96 feet	1.16	37.44	8.47	5.77	564,527
6	Portion of sewer from Visitation street to Cote à Baron,—length 1055 feet; fall 7 48 feet	0.90	37.44	7.46	5.08	284,853
6	Portion of sewer from Fullum street, west along said street, thence north along low ground,—length 5250 feet; fall 8.49 feet	0.90	8.53	3.56	2.42	135,698
7	Portion of sewer from Guy street, along St. Catherine street, to McGill College avenue,—length 3085 feet; fall 29.10 feet	0.73	49.80	7.75	5.28	204,069
7	Portion of sewer from McGill College avenue to Berthelet treet,—length 2,445 feet; fall 11.47 feet	0.73	24.76	5.46	3.72	143,773
4	Portion of sewer along Papineau Road—length 2032 feet; fall 2.79 feet	1.16	7.24	3.72	2.53	247,531
4	Do. do. length 1731 feet; fall 36.82 feet	1.16	112.31	14.95	10.19	996,973

TABLE No. 4.

Table showing the quantity of earth required for the grading of the several streets through which the main Sewers pass, as now proposed to be raised and formed.

Name of Street.	Average depth to be raised.	Width of Street in feet.	Length of Street in feet.	Cubic yards of filling required.
From Papineau Road to Ruisseau Migeon (new road proposed to be 100 feet wide)	′ ″ 5.3	100	10300	200,277
Along St. Bonaventure street, from St. Margaret street to City Boundary	2.6	40	5030	18,629
Along William street, from Ann street to Richmond street	2.0	Ave 55	3165	12,894
Along Wellington street, from Wellington Bridge to Grand Trunk Railway	2.2	60	3095	14,856
From St. Charles Borromée street, along low ground, to Cote à Baron	7.2	60	2578	41,018
Sherbrooke street sewer, from Drummond street to McGill College avenue	1.6	90	1500	7,500
From Bleury street to St. Catherine street ..	4.5	60	2000	20,000
From junction of Victoria street with Sherbrooke street, then along Victoria street to a point in line with Berthelet street, thence to Union Avenue	3.10	60	1027	10,354

TABLE No. 5.

Table of the Rainfall and Snowfall in the City of Montreal, for the year 1856, and from the year 1836 to 1840, inclusive.

	1856.				
	Rain.	SNOW.		Total of Snow and Rain reduced to Rain.	REMARKS.
		Snow in inches in depth.	Reduced to cubic inches of rain.		
January ..	..	29.50	2.72	2.72	
February ..	0.18	12.75	1.37	1.55	
March	..	24.01	1.95	1.95	The observations were taken in 1856 by Dr. Hall, and for the other years by Judge McCord.
April	1.51	Inap.		1.51	
May	2.77			2.77	
June	1.14			1.14	
July	2.49			2.49	
August ..	5.38			5.38	
September ..	1.41			1.41	
October ..	4.09			4.09	
November ..	2.21	6.01	0.13	2.34	
December ..	0.02	32.03	3.21	3.23	
Total fall during 1856				30.58	
Average per month				2.54	

	1856.				1857.				Mean Rain per Square Mile of surface.	Average of Snow for the Winters of 1856 & 1857.
	Rain.	SNOW.		Total of Snow and Rain reduced to Rain.	Rain.	SNOW.		Total of Snow and Rain reduced to Rain.		
		Snow in inches in depth	Reduced to cubic inches in rain.			Snow in inches in depth.	Reduced to cubic inches in rain.			
January ..	..	29.50	2.72	2.72	..	22.07	1.67	1.67	2.19	3.97
February ..	0.18	12.75	1.37	1.55	1.06	37.01	5.33	6.39	3.97	2.82
March	..	24.01	1.95	1.95	1.64	21.03	2.05	3.69	2.82	

	1836	1837	1838	1839	1840	Average	
Rain	34.00	34.25	32.50	43.00	38.50	36.45	Average of the Rain and Snow from 1836 to 1840 inclusive.
Snow	25.75	13.00	16.50	13.75	21.00	18.00	